

University of Northern Colorado

## Scholarship & Creative Works @ Digital UNC

---

Dissertations

Student Research

---

5-2020

### **Socio-Emotional and Socio-Cultural Perceptions of Young Women and Their Interests in Science, Technology, Engineering, and Mathematics**

Danielle Ann Riney

Follow this and additional works at: <https://digscholarship.unco.edu/dissertations>

---

© 2020

DANIELLE ANN RINEY

ALL RIGHTS RESERVED

UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

SOCIO-EMOTIONAL AND SOCIO-CULTURAL  
PERCEPTIONS OF YOUNG WOMEN AND  
THEIR INTERESTS IN SCIENCE,  
TECHNOLOGY, ENGINEERING,  
AND MATHEMATICS

A Dissertation Submitted in Partial Fulfillment  
of the Requirements for the Degree of  
Doctor of Education

Danielle Ann Riney

College of Education and Behavioral Sciences  
School of Teacher Education  
Educational Studies

May 2020

This Dissertation by: Danielle Ann Riney

Entitled: *Socio-emotional and Socio-cultural Perceptions of Young Women and their Interests in Science, Technology, Engineering, and Mathematics.*

has been approved as meeting the requirement for the Degree of Doctor of Education in College of Education and Behavioral Sciences in School of Teacher Education, Program of Educational Studies.

Accepted by the Doctoral Committee

---

Heng-Yu Ku, Ph.D., Research Advisor

---

Michelle Holmes, Ph.D., Committee Member

---

Christine Kyser, Ed.D., Committee Member

---

Thomas Morgan, Ph.D., Faculty Representative

Date of Dissertation Defense \_\_\_\_\_

Accepted by the Graduate School

---

Cindy Wesley, Ph.D.  
Interim Associate Provost and Dean  
Graduate School and International Admissions



## ABSTRACT

Riney, Danielle Ann. *Socio-emotional and Socio-cultural Perceptions of Young Women and their Interests in Science, Technology, Engineering, and Mathematics*.  
Published Doctor of Education Dissertation, University of Northern Colorado,  
2020.

School districts across the United States have begun to focus on the holistic learning of their students. At the top of that focus is student learning in socio-emotional and socio-cultural areas, in addition to content areas. This dissertation utilized an explanatory sequential design mixed methodology to explore the socio-emotional competence and socio-cultural perspectives of middle school students in STEM. Through a Likert scale survey and open-ended question, responses of 137 students were gathered to complete factor analysis, compute descriptive analysis, and calculate statistical differences found between genders through the use of *t*-tests to quantitatively answer research questions one and two. Also used to answer research question two was an open-ended question. For the qualitative portion of the study, 12 female students were selected from the highest six scores and lowest six scores on the Likert survey to answer research questions three and four. These 12 participants were interviewed with open-ended questions regarding their socio-cultural influences. There were three theoretical frameworks used to drive the research of this study: gender equality, care theory, and self-efficacy. Analysis and discussions were completed to answer research questions one and two. Significant statistical differences were found between male and female participants in socio-emotional competence, in the factor of social-awareness. For research question

three, higher scoring female participants shared that they felt stereotyping in STEM was an idea of the past, they displayed strong relationships with educators, they surrounded themselves by STEM interested peers, and explained their perseverance to push themselves to be successful. For research question four, the lower scoring female participants believed that stereotyping of genders in STEM was still current, they indicated mixed relationships with educators, they followed peers regardless of interest in STEM, and exhibited lesser self-efficacy in the school setting. Findings from this study have yielded new foci for educators regarding social-awareness in the classroom. The findings also suggest the significance of educators being cognizant of their influences in the classroom. Additionally, a discussion is made about the importance of positive learning experiences for students, particularly females, in STEM areas. Parents/guardians also have an important role in encouraging their students in STEM.

*Keywords:* middle school, socio-cultural influences, socio-emotional competence, STEM

## **ACKNOWLEDGEMENTS**

Walking into my classroom, the smiling faces of students with eyes eager to learn are focused upon me. The role of an educator is incredibly important and is all too often ignored or taken for granted. Educators hold to mold the impressionable minds of the future leaders, the future scientists, the future technological geniuses, the future engineers, the future mathematicians; each student inquiring day-in and day-out for more information to fill their curious minds. The educator role fulfills many facades: content enricher, socio-emotional supporter, relationship builder, cheerleader, coach, and even a shoulder to cry on. Each student deserves the best, caring relationship from their teacher who at the same time continues to push their students out of their comfort zones to enlightening in areas their students have never even known. This dissertation was written to for all the educators and administrators out there, in the hopes that we engage and encourage our students to love education as much as we do.

To Dr. Ku: Thank you for taking the time to help me grow in my abilities as a doctoral student. Under your guidance, my understanding of quantitative and qualitative methods has grown exponentially. I appreciate your help in strengthening my grit. I learned how to persevere through this process with the support of countless emails, phone calls, and Skype conversations. I truly appreciate all your help.

For my parents and family: Thank you for reading numerous chapters and thank you for the continued support and confidence. Dad and Mom, thank you for always

helping me to realize my potential. The conversations we have had throughout my life have helped me to realize that I can do whatever I set my mind to.

For my daughter: The world is your oyster. There is so much to learn and grow from, I hope that you see hard work and support can help you go wherever you want to go. I love you E-bug. As your favorite character would say: “You are braver than you believe, stronger than you seem, and smarter than you think.” – Winnie the Pooh, A.A. Milne.

For my husband, I know and appreciate, beyond words, how many countless hours you filled the duty of both parents. I appreciate the love you have showed me while I have embarked upon this journey. You have been my rock through this large undertaking. I want to thank you for everything you have done to help make this entire process a success. I love you.

## TABLE OF CONTENTS

### CHAPTER

I. INTRODUCTION .....	1
Statement of the Problem	
Rationale of the Study	
Purpose Statement	
Research Questions	
Significance of the Study	
Definitions of Key Terms	
Summary	
II. REVIEW OF THE LITERATURE .....	19
Science, Technology, Engineering, and Mathematics	
Middle School Education	
Socio-Emotional Interest	
Socio-Cultural Influence	
Summary	
III. RESEARCH METHODOLOGY .....	50
Philosophical Perspective	
Researcher Stance	
Mixed Methods Design	
Participants and Setting	
Materials	
Procedures	
Data Analysis	
Summary	
IV. RESULTS .....	84
Research Question One	
Research Question Two	
Research Question Three	
Research Question Four	
Summary	

IV. DISCUSSIONS AND CONCLUSIONS .....	144
Research Question One	
Research Question Two	
Research Questions Three and Four	
Contributions to the Field	
Suggestions for Future Studies	
Limitations of the Study	
Final Reflections	
Summary	
REFERENCES .....	176
APPENDIX	
A. Institutional Review Board Approval .....	196
B. School District Consent Form .....	200
C. Parental Consent Form .....	202
D. Participant Assent Form.....	204
E. Student Survey Questions.....	206
F. Semi-Structured Interview Questions.....	210
G. Draft of Recruitment Communication .....	212
H. Draft of Recruitment Email for Students .....	214

## LIST OF FIGURES

### FIGURE

1. The Relationship Between SEL for Success The Relationship Between SEL for Success (Duckworth et al., 2007; Dweck, 2008).....	35
2. Four step process used for the research of explanatory sequential design for this research .....	61
3. The classroom where interviews took place .....	65
4. Boxed time showing academic extension .....	66
5. Participant Means.....	68
6. Example of field notes taken after interviews.....	73
7. Example of member checking via email.....	73

## LIST OF TABLES

### TABLE

1. Data sources and analysis by research questions .....	80
2. Correlations among socio-emotional questions .....	87
3. Anti-image socio-emotional correlation matrix.....	88
4. Total variance of the socio-emotional section of the Likert survey .....	89
5. Cronbach's alpha for socio-emotional survey .....	90
6. Socio-emotional factor analysis component matrix loadings for Likert survey (N=137) .....	92
7. Grit questions showing overall mean.....	94
8. Self-efficacy questions showing overall mean .....	95
9. Social-awareness questions showing overall mean .....	96
10. Descriptive Statistics for grit comparing male and female participant responses .....	97
11. Descriptive Statistics for self-efficacy comparing male and female participant responses .....	97
12. Descriptive Statistics for social-awareness comparing male and female participant responses .....	98
13. Correlations among socio-cultural questions.....	101
14. Anti-image socio-cultural correlation matrix.....	101
15. Total variance of the socio-cultural section of the Likert survey .....	103
16. Cronbach's alpha for socio-cultural survey .....	104



17. Socio-cultural factor analysis component matrix loadings for Likert survey (N=137) .....	106
18. Socio-cultural influences questions showing overall mean .....	108
19. Personal focus in STEM questions showing overall mean .....	109
20. Descriptive Statistics for social-cultural influences comparing male and female participant responses .....	110
21. Descriptive Statistics for personal focus in STEM comparing male and female participant responses .....	110
22. Frequencies of responses for question 34 .....	113
23. Interview Questions used to show socio-cultural perspectives .....	115
24. Higher scoring female participant example responses and themes .....	127
25. Lower scoring female participant example responses and themes .....	140
26. Higher and lower scoring female participant themes .....	157

## **CHAPTER I**

### **INTRODUCTION**

The U.S. Department of Education, Office of Innovation and Improvement, (2016) has shared a response about STEM (science, technology, engineering, and mathematics) focused learning in the country: “A strong STEM education—one that results in the skills and mindsets...opens the door for lifelong learning—starts as early as preschool, is culturally responsive, employs problem - and inquiry-based approaches, and engages students in hands-on activities that offer opportunities to interact with STEM professionals” (p. 1). The STEM education of today and its needs has developed from the science and mathematics educations received since the Sputnik era (Drew, 2015). Moore and Simon (2000) shared that the 20<sup>th</sup> century allowed for more progress “in the United States in this century than for all people in all previous centuries of human history combined” (p. 76).

In the 1960s, research explained that through the investment in education, the potential for real capitalism in production would become relational to the “more technologically progressive the economy” (Nelson & Phelps, 1966, p. 75). Reports also showed increasing numbers of individuals focused on formal and higher learning (Cohen, 1967). American education was upheld as the tool for societal success and for individual progress towards fulfilling goals (Cohen, 1967). It was during this time that the education system provided by schools, universities, and businesses were successfully training

students for the positions available. Constable and Somerville (2003) shared 20 advances in engineering in the 20<sup>th</sup> century. Those advances are aeronautics, aerospace, agriculture, air conditioning and refrigeration, automotive, computers, electronics, electricity, health technology, high-performance materials, highways, household appliances, imaging, internet, lasers and fiber optics, nuclear technology, petroleum and petrochemical technology, radio and television, telephones, and water supply and distribution (Constable & Somerville, 2003).

With such incredible contributions to the 20<sup>th</sup> century, the outlook for advances in the 21<sup>st</sup> century has changed. Durović (2016) explained that technological modifications would allow for a greater focus on STEM areas. However, even with those variations, many “wonder if it will be possible and/or desirable to continue along the path of such prodigious changes?” (Durović, 2016, p. 13). Vision statements have proposed reform of STEM education to meet the needs of the future (U.S. Department of Education, Office of Innovation and Improvement, 2016). Reforming STEM education should:

Nurture and spread effective STEM learning opportunities for all youth through a national community of practice composed of local networks that work together to create an engaged community of STEM teaching and learning the role and potential success of education in today’s world. (U.S. Department of Education, Office of Innovation and Improvement, 2016, p. 31).

In Friedman’s (2007) *The World is Flat*, the outsourcing, open-sourcing, offshoring, push for education contained a viewpoint of the world and how the world is addressed. Friedman (2007) noted that the world has shrunk “from a size small to a size

tiny and [is] flattening the playing field at the same time” (p. 10). This viewpoint has been seen in a variety of fields, particularly the STEM fields. In *Frictionless Markets: The 21<sup>st</sup> Century Supply Chain*, Buffington (2016) shared Robert Gordon's idea that “the impact of innovation in the future is overrated, while the threats posed by structural problems, such as education declines, have been understated” (p. 21). The Department of Education has “recognized in the Every Child Succeeds Act (ESSA), President Obama’s Computer Science for All initiative, and the competitive priority to focus attention on STEM in several of the Department’s discretionary grant programs, STEM is a crucial component of a well-rounded education for all students—an education that provides access to science, social studies, literature, the arts, physical education and health, and the opportunity to learn an additional language” (U.S. Department of Education, Office of Innovation and Improvement, 2016, p. 1). After all, knowledge is shaped by human capital gains (Spring, 2014). The United States developed and changed the way the educational system existed as a result of a need for economic competition and effort to make the United States secure.

A variety of educational reforms have come into focus. The Elementary and Secondary Education Act was passed as a part of the Johnson administration (Spring, 2014). This act attempted to shorten the gaps between students in low socio-economic and high-socioeconomic schools while helping students to achieve an exceptional education (Spring, 2014). In 1983, *A Nation at Risk* targeted schools as being noncompetitive in world markets during the Reagan administration (U.S. Department of Education, The National Commission on Excellence in Education, 1983). The Bush administration created the National Council on Education Standards and Testing to

standardize objectives and learning along with helping to emphasize behavioral objectives (Spring, 2014). In 1991, the difference in achievement between genders was brought to attention through the American Association of University Women (1991). Gilligan, a part of the American Association of University Women (1991) shared in a video:

Girls are very good observers of the world around them. They're clear about their feelings. As 8-year-olds, they're outspoken and disagree publicly, but as they come to adolescence, the questions they begin asking are considered disruptive and get them in trouble, and they retreat. The commonly heard phrase, "I don't know," starts at seventh grade but the fact is they do know. (American Association of University Women, 1991, Video file).

In the second half of the 1990s, the *Goals 2000 Education America Act* was passed, tasking schools with the idea to improve competition in world markets (Spring, 2014). The No Child Left Behind Act of 2002 was established to attempt a uniform standard and tests system within the United States (Spring, 2014). The National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2007) met to discuss the needs and functions of STEM in the United States. The committees reported that "Other nations have learned from our history, however, and they are boosting their investments in science and engineering education because doing so pays immense economic and social dividends" (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007, p. 94). The report suggested that K-12 schools in the United States faced challenges in student preparation, interest, attrition,

and inadequate preparation in the STEM fields (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007). As the committee looked at results for the actions, it was suggested that student learning had not improved (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2007). In 2010, the committee responded with an analogy of torrential hurricanes, noting the idea that the “*Gathering Storm* increasingly appears to be a Category 5” (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, 2010, p. 5). In 2016, Kramer reported in *The Gathering Storm Still Looms* the results of the United States STEM programs. The report shared that the United States had placed 36<sup>th</sup> in mathematics and 28<sup>th</sup> in science among the 65 nations that had assessed its students (Kramer, 2016).

More recently, The National Science Board (2018) reported that “Raising overall student achievement, reducing performance gaps among different groups, increasing advanced course-taking, recruiting more STEM teachers, and improving college readiness in mathematics and science” were the focused priorities in education for the United States (p. 105). While investments in education have taken place, increasingly concerning for educators is the thought that students are not competitively ready or interested in continuing in the STEM field as potential careers as noted through the report from National Science Board (2018). The National Science Board (2018) explained the following:

- “Less than half of fourth, eighth, and twelfth-grade students achieved a level of proficient (defined as “solid academic performance”) or higher on National

Assessment of Educational Progress (NAEP) mathematics and science assessments in 2015” (p. 4).

- “In the international arena, the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA) 2015 data show that the U.S. average mathematics assessment scores were well below the average scores of the top-performing education systems” (p. 5).
- “Significant racial and ethnic differences persisted, with white and Asian or Pacific Islander students having higher graduation rates than other racial or ethnic subgroups” (pp. 4-5).

With these differences in STEM education for the students in the United States, research has shown a variety of methods to accomplish these differences, primarily through educating and training all populations of learners as best as possible (Piper & Krehbiel, 2015). Some resources have suggested that the best method of teaching students relies upon the engagement of students (Lee, Hayes, Seitz, DiStefano, & O'Connor, 2016; Pitzer & Skinner, 2017). Pitzer and Skinner (2017) wrote that “Students perform better in school to the extent they are able to engage fully, cope adaptively, and bounce back from obstacles and setbacks in their academic work” (p. 1). The STEM engagement and interest levels of middle school students are particularly concerning (Britner & Pajares, 2006).

### **Statement of the Problem**

According to Greenberg, Domitrovich, Weissberg, and Durlak, (2017), “The ultimate goal of public health is to improve the general population’s wellbeing” (p. 14). With the competitive nature of programs like Race to the Top (Spring, 2014) and a need

to have students in the United States place in the top in STEM education internationally (Obama, 2009), reform in education is needed. With these extrinsic pushes to modify education, STEM at the middle school level is focused upon young women, as seen through a variety of drives to engage female students (Bhargava & Witherspoon, 2015).

Three main ideas bring attention to reform in STEM education at the middle school level. The first focus is upon the idea that the socio-emotional perspectives and socio-cultural influences of young women and young men differ (Bhargava & Witherspoon, 2015; Payton, et al., 2000). The second emphasis for needed reform drives itself from engagement and relationships between students and their educational interests (Dweck, 2008; Noddings, 2005). This drive has potentially strengthened STEM learning and connectedness in an effort to increase engagement. Finally, STEM education has sought to drive the interest levels of young women in STEM at the middle school level to solidify interests and change perspectives of STEM education (U.S. Department of Education, Office of Innovation and Improvement, 2016).

### **Rationale of Study**

Lee et al. (2016) stated that “Middle school has been documented as the period in which a drop in students’ science interest and achievement occurs” (p. 1). With student interest and engagement as a primary focus for the teaching of middle school students, a reevaluation of student grit, self-efficacy, and social awareness are brought forward. Research has shared that students lose interest in middle school STEM areas which then results in less success in high school STEM and lesser likelihood of continuing through STEM in college (Britner & Pajares, 2006; Lee et al., 2016; Pitzer & Skinner, 2017). STEM interest may flounder as many female students “are less likely to receive familial,



teacher, or peer support to pursue education in the STEM disciplines” than their male counterparts (Ogle, Hyllegard, Rambo-Hernandez, & Park, 2017, p. 34). Although it has seemed that opportunities for female students are gaining, areas in STEM still show a need for equal female representation (Hansen & Jones, 2011; National Student Clearinghouse Research Center, 2015).

Sadker, Sadker, Zittleman, and Sadker (2009) explained the need for equal representation through the following: “Only one in five engineers is female, two-thirds of physics majors are male, and a lower percentage of females are studying computer science today than a decade ago...” (p. 2). A 2010 journal article explained that statistically, there are far fewer women going into scientific careers (American Association of University Women, 2010). There are only 15.1% of women going into science, engineering, and technology, while 29.3% of men are interested in majoring in those same areas (American Association of University Women, 2010). More recently, the U.S. Department of Education, National Center for Education Statistics [NCES] (2017) shared gender percentages of bachelor’s degrees earned:

- Women earned 59.9% of biological and biomedical sciences bachelor’s degrees.
- Women earned 9.9% of computer and information sciences bachelor’s degrees.
- Women earned 19.9% of engineering and engineering technologies and engineering-related fields bachelor’s degrees.
- Women earned 10.6% of physical sciences and science technologies bachelor’s degrees.
- Women earned 8.7% of mathematics and statistics bachelor’s degrees.

Research has suggested the differences in STEM learning between men and women is slight (Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000; Brody & Mills, 2005; Hyde, Mertz, & Schekman, 2009; Stoet & Geary, 2018). However, there are additional descriptors shown that acknowledge differences exist between men and women (National Science Board, 2018; Stoet & Geary, 2018). For instance, Stoet and Geary (2018) shared that "...boys often expressed higher self-efficacy, more joy in science, and a broader interest in science than did girls..." (p. 588). The National Assessment of Educational Progress showed tested differences between young men and young women (National Science Board, 2018). Regarding the science portion of the Trends in International Mathematics and Science Study (TIMSS) assessment, the average scores between young men (533) and women (527) were six points difference in eighth grade (National Science Board, 2018). The TIMSS mathematics average scores showed a difference of two between young men (519) and women (517) in eighth grade (National Science Board, 2018). However, by the time young men and women are tested in high school for the TIMSS assessment in mathematics and physics, there is a stark difference between genders, young men score an average of 455 whereas young women score an average of 409, noting a difference of 46 (National Science Board, 2018).

Student opinions change regarding STEM education by the time male and female students reach the high school level. Student success drives the engagement and interest in STEM. For high school level STEM classes, that success correlates with student STEM career choice (Eccles & Wang, 2016). Eccles and Wang explained that "Females placed more value than males on putting family needs before work, working with people, and having an altruistic job, while males placed more value on working with things,

making more money, and seeking out high risk and high status tasks” (2016, p. 102).

Eccles and Wang (2016) explained that interventions for young women before high school should focus on engagement in STEM instead of “increasing their sense of math ability self-concept” (p. 104). Through changing the interest and engagement in STEM, there may be new mindsets that are altered for young women in STEM courses. This, in turn, may change the number of students interested in STEM.

### **Socio-Emotional Learning**

Focusing on the idea of student engagement and social learning at the middle school level, many middle schools have opted into studying and reviewing areas that middle school students struggle with (Panorama Education, 2018). In Panorama Education (2018), socio-emotional learning (SEL) is defined as “the critical skills and mindsets that enable success in school and in life” (Panorama Education helps educators section, para. 1). According to Greenberg et al., (2017), SEL lessons have helped support a holistic individual understanding of education from three perspectives:

1. SEL lessons in schools can work with students for multiple years for a more significant amount of time.
2. SEL lessons can help to “improve students’ competence, enhance their academic achievement, and make them less likely to experience future behavioral and emotional problems” (p. 14).
3. SEL lessons in all schools could help public health with interventions.

Schueller and Seligman (2010) reported the idea that successful professionals recognized engagement and meaning, stemming from their secondary educations, towards their careers as the direct route to success and contentment. There are a variety of

studies on mindsets and social learning of students (Blackwell, Trzesniewski, & Dweck, 2007; Dweck, 2008; Dweck & London, 2004; Grant & Dweck, 2003). The importance of SEL for students can build upon the two main ideas regarding student mindset: that intelligence is changeable and that knowledge can be developed (Blackwell, et al., 2007).

To compete with the demands and needs of the STEM industry, in particular, “people need to balance sets of cognitive, social, and emotional capabilities” (Trip, 2017, p. 1). Across the United States, schools are seeking new methods to reach their students via socio-emotional learning. Dweck (2007) and Noddings (2003) each have suggested building positive relationships with students, thus contributing to student learning successes in the classroom. There is a need for socio-emotional learning to help build this relational understanding (Devis-Rozental, 2018; Payton, et al., 2000). There is also a need to build the skill sets to help students prepare for complications in their futures. According to Haley, Oberle, Durlak, and Weissberg (2017), SEL interventions may be able to help students in their futures. In many middle school learning environments, school districts have encouraged SEL to promote “healthy relationships, school connectedness, and dropout prevention” (Thapa, Cohen, Guffey, & Higgins-D’Alessandro, 2013, p. 357).

Three main components of socio-emotional learning are grit, self-efficacy, and social-awareness. These three areas are focused upon in the middle school level as the areas of most concern through student testing (Panorama Education, 2018). Each of these focuses is defined below.

**Grit.** Grit is an area of SEL can be defined as “perseverance and passion for long-term goals” (Duckworth, Peterson, Matthews, & Kelly, 2007, p. 1087; Panorama

Education, 2018). Flanagan and Einarson (2017) suggested that confidence is built from perseverance and passion. The performance of a student is directly related to their confidence (Flanagan & Einarson, 2017). Flanagan and Einarson (2017) further explained that student grit determines how successful a student is in class. It is even thought that grit may be one of the essential mindsets for success in high achievement fields, such as some STEM-focused areas (Duckworth et al., 2007). Grit is relational to happiness through engagement (Von Culin, Tsukayama, & Duckworth, 2014). The amount of effort one puts forward was also shown to be driven by individual grit (Von Culin et al., 2014).

**Self-efficacy.** Another area of SEL is the area of student self-efficacy (Panorama Education, 2018). Self-efficacy is defined as “individuals’ perceptions about their capabilities for learning or performing tasks within specific domains” (Summers & Falco, 2018, p. 2). Summers and Falco (2018) explained that students who practice strong self-efficacy tend to set and reach difficult goals while adjusting their learning environments for continued success. These authors suggested that students may be influenced through social emotional learning to build stronger self-efficacy by positive interactions, relationships, feedback, and even through comparisons with peers (Summers & Falco, 2018).

**Social-awareness.** The tools that students learn while focusing on social-awareness allow for building skill sets that help students interpret other people accurately and help to navigate social interactions (Jones, Barnes, Bailey, & Doolittle, 2017). Social-awareness also provides situations for positive relationships for both peers and adults (Jones et al., 2017). Furthermore, students using social-awareness learn to

collaborate and can solve problems in a social situations while working well with those around them (Jones et al., 2017).

### **Socio-Cultural Learning**

While socio-emotional learning in middle school helps form an understanding and growth for the student (Thapa et al., 2013), there is a need also to understand the socio-cultural learning of students. The involvement of parents/guardians, communities, and friends of a middle school student plays an essential role in student academic successes and aspirations. Through parent/guardian participation in both the home and school setting, students may receive additional academic supports leading to a more friend academic socialization of learning (Bhargava & Witherspoon, 2015).

Students' differing cultures suggest more opportunities to learn from one another (Pinxten, 2015; Upadhyay, Maruyama, & Albrecht, 2017). Upadhyay et al. (2017) have suggested that using "students' skills and knowledge from home and other sociocultural experiences into science classroom instructions for sociopolitical awareness" can help strengthen classroom learning (p. 2544). The more opportunities for students to learn from those around them, the more likely they are to enhance their socio-cultural learning abilities. Also, the influence that educators play in the classroom may drive the educational support and engagement of students (Ebadi & Gheisari, 2016).

Young women start their education interested and intrigued by STEM. However, during those formative middle school years, STEM begins to become uninteresting and unengaging (Lee et al., 2016). There is a need for research to address how genders express socio-emotional perspectives involving STEM regarding the areas of grit, self-

efficacy, and social-awareness. Also, research should address the socio-cultural influences of middle school women and their STEM learning.

### **Purpose Statement**

The purpose of this mixed methods study was to examine the gender differences of socio-emotional STEM learning while also investigating the socio-cultural perspectives of young women with higher levels of socio-emotional STEM learning and lower levels of social-emotional STEM learning. Through interviews with young women, the social-cultural interests of young women with higher and lower socio-emotional STEM learning was explored. Interviews with the higher and lower scoring female participants contributed to a deeper understanding of how and why students embark upon their learning. This researcher hopes that a reevaluation of STEM education regarding the engagement of students, particularly middle school young women, may take place.

### **Research Questions**

Four questions will be focused upon for this research.

- Q1     Are there significant gender differences in the socio-emotional interests (grit, self-efficacy, and social-awareness) of middle school students found through the student survey questions?
- Q2     Are there significant gender differences in the socio-cultural influences of middle school students found through the student survey questions?
- Q3     What socio-cultural perspectives do middle school young women with higher socio-emotional and socio-cultural STEM interests have?
- Q4     What socio-cultural perspectives do middle school young women with lower socio-emotional and socio-cultural interests have?

### **Significance of the Study**

Relationships are essential tools for middle school educators and students when attempting to build engagement and interest of students (Noddings, 2003). Relationships are particularly important regarding the influence of STEM. For many educators, it is necessary to build student/teacher relationships and is also essential to learn how the socio-emotional and socio-cultural perspectives of students can help or deter from building those relationships (Greenberg et al., 2017; Jones et al., 2017).

This study evaluated the socio-emotional competence differences in STEM between young women and men while also examining the socio-cultural STEM influences of young women at the middle school level. Through this research, a new educational understanding of STEM interest regarding middle school students was explored. The benefits of this research may help to reform STEM education by focusing on socio-emotional competence and socio-cultural interests to increase interest and engagement. This study may create new ideas for professional development to help ensure relationships are built between student and educator through focusing on student socio-emotional interests and socio-cultural influences.

### **Definitions of Key Terms**

**Grit.** The U.S. Department of Education, Office of Educational Technology, (2013) has defined grit as “perseverance to accomplish long-term or higher-order goals in the face of challenges and setbacks, engaging the student’s psychological resources, such as their academic mindsets, effortful control, and strategies and tactics” (p. 15).

**Mindset.** Carol Dweck (2008) described mindset as the “different beliefs about intellectual abilities” (p. 2). The U.S. Department of Education, Office of Educational Technology (2013) has defined an academic mindset as “how students frame themselves



as learners, their learning environment, and their relationships to the learning environment. Mindsets include beliefs, attitudes, dispositions, values, and ways of perceiving oneself” (p. 15).

**Self-efficacy.** Bandura (1997) explains self-efficacy “as people’s beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives” (p. 1). The U.S. Department of Education, Office of Educational Technology (2013) has defined self-efficacy as the “belief in their ability to learn and perform well” (p. 23).

**Social-awareness.** Peters-Burton and Mattietti (2017) explain social-awareness as “a greater understanding of themselves as learners” (p. xxv).

**Socio-emotional learning.** As defined by Collaborative for Academic, Social, and Emotional Learning [CASEL] (2018), “Social and emotional learning (SEL) is the process through which children and adults acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions” (What is SEL? Section, para. 1).

**Socio-cultural.** Vygotsky (1978) described the sociocultural theory as the method that children learn through social interactions while also explaining how the tools developed from their cultures are utilized. Described by Bhargava and Witherspoon (2015), the socio-cultural description includes a variety of factors, most relevant to this study: family SES, neighborhood, social relationships between peers and family, and teacher relationships.

**Science, Technology, Engineering, and Mathematics (STEM).** As defined per the U.S. Department of Education (n.d.), the “types of skills that students learn by studying science, technology, engineering, and math—subjects collectively known as STEM”. The U.S. Department of Education, Office of Innovation and Improvement, (2016) explained that STEM is an important part of education that allows connectivity of the areas of science, technology, engineering, and mathematics but also interdisciplinary connections to reading, writing, art, physical education, and more.

### **Summary**

Future STEM advancements require educated and engaged students to study and embark upon new technologies (U.S. Department of Education, Office of Innovation and Improvement, 2016). As students continue to move into roles in the STEM fields, socio-emotional learning is an ever-important focus in the mindsets of students (CASEL, 2018; Summers & Falco, 2018). Interestingly enough, it may be through peer relationships, parent/guardian influences, educator inspiration, and even extracurricular activities that may further change the mindsets of students into being capable to taking on a STEM career (Bhargava & Witherspoon, 2015; Dweck, 2008; Jones et al., 2017; Noddings, 2005; Thapa et al., 2013). The interests and engagements of students in STEM may guide the social-emotional learning that is required for students to be successful in STEM, particularly female students. This study explored how the ideas of socio-emotional STEM engagement and perspectives of young students at the middle school level and female socio-cultural influences.

The research site for this study was conducted at a secondary middle school building. Following district and parental consent, students completed a survey regarding

the SEL interests regarding STEM. Students also completed opened-ended questions regarding their interests and engagements in STEM. The study was further designed to embark upon the interests and engagements that students, particularly female students, had regarding how they scored in the survey. The data from students from all three grade levels at the middle school was analyzed to find the higher and lower scores of female students. These students were contacted and interviewed to inquire upon socio-cultural influences and interests.

The purpose of this mixed methods study was to explore STEM areas of socio-emotional and socio-cultural perspectives of students, gender biases in STEM education, and the connection to social sciences and constructive frameworks. Four questions are used to organize and explore these ideas. Through this study, inferences were made from the four research questions that contribute to a potential need for change in socio-emotional and socio-cultural learning of students at the middle school level, particularly regarding STEM.

## **CHAPTER II**

### **REVIEW OF THE LITERATURE**

For this research, I wanted to embark upon understanding the educational world when facing gender differences regarding STEM subjects. Knowing that there are far fewer women going into STEM careers than their male counterparts, this research investigated the discrepancies for why the genders choose the paths towards or away from STEM areas (American Association of University Women, 2010; NCES, 2017). Educators, administrators, and school districts have connected how the whole student, including the socio-emotional and academic individual, may correlate for student success (Jones et al., 2017). School districts are devoting time to the whole child through socio-emotional learning as this is vital to helping build relationships and develop individuals who can be successful in the future (Jones et al., 2017). Additionally, noting that middle school is the make or break time for some students regarding their engagement in STEM (Lee et al., 2016), I wanted to investigate the socio-cultural surroundings of students that may be guiding and engaging students towards or away from STEM fields at the middle school level (Bandura, 1997; Bhargava & Witherspoon, 2015).

This chapter connects literature involving STEM learning and the socio-emotional interest and social-cultural influences of students at the middle school level. Also investigated in this chapter are the gender biases found in STEM careers. Current research is shared regarding STEM learning. Research also included information pertaining to middle school education and the importance of engagement in STEM

learning. This chapter also details socio-emotional learning of students and the socio-cultural surroundings of students.

### **Science, Technology, Engineering, and Mathematics**

In 2005, the Gates Foundation helped a National Education Summit to reflect on education in the United States. During the press release Gates (2005) shared how different schools of the past are compared to today, noting that reform is necessary. Gates (2005) continued to share:

When I compare our high schools to what I see when I'm traveling abroad, I am terrified for our workforce of tomorrow. In math and science, our 4<sup>th</sup> graders are among the top students in the world. By 8<sup>th</sup> grade, they're in the middle of the pack. (para. 26)

STEM education is crucial to ensure that students are competitive in STEM for the future (Drew, 2015; Obama, 2009).

### **History of Science, Technology, Engineering, and Mathematics**

In the height of the cold war, the United States competed to become a leader in the world regarding the space program (Drew, 2015). In 1958, the National Defense Education Act (NDEA) was developed to provide funding to “strengthen the national defense and to encourage and assist in the expansion and improvement of educational programs to meet critical national needs” of the United States (U.S. Committee on Education and Labor, 1964, para. 1). In 1958, after reviewing the NDEA, chairman Barden explained the needs of education by sharing:

It is no exaggeration to say that America's progress in many fields of endeavor in the years ahead—in fact, the very survival of our free

country—may depend in large part upon the education we provide for our young people now (History, Art & Archives, U.S. House of Representatives, 2018, para. 1).

NDEA helped to reform and start a focus in STEM education by funding classrooms and providing student loans (Bybee, 2013; Drew, 2015).

In 1961, President Kennedy requested that Congress push for a leading role in the space industry. President Kennedy explained his hopes for the United States leading the world with “science and industry, our hopes for peace and security, our obligations to ourselves as well as others, all require us to make this effort, to solve these mysteries...to become the world’s leading space-faring nation” (1961, para. 12). As STEM education continued to evolve in the United States, some ideas were successful but many ideas that failed (Drew, 2015; Spring, 2014). In the 1960s, it seemed as though the main focus of STEM education came from science and mathematical areas (Bybee, 2013; Drew, 2015). Bybee (2013) explained that the U.S. Commissioner of Education in 1963 had invested more money into education than it previously had and due to this, had expected great results for the money spent. However, following the early 1960s, a focus upon social-awareness allowed for an era of educational criticisms where “constructive solutions were few, shallow, narrow, and short-lived” (Bybee, 2013, p. 18). The education curriculum was reevaluated as teachers worked along scientists, mathematicians, and engineers to solidify student learning (Bybee, 2013). However, by 1976, curriculum reform in STEM ended due to financial objections (Bybee, 2013).

After the educational reform of the 1960s, STEM education grew. Reform came from Goals 2000 and modified into No Child Left Behind and morphed into Race to the

Top where standards-based learning and assessment testing had become the primary focus in STEM (Bybee, 2013; Drew, 2015; Obama, 2009). The phrase STEM was adopted from the National Science Foundation's acronym. The National Science Foundation explained that STEM curriculum was important but was also useful in other disciplinary areas (Bybee, 2013). However, the dilemma in STEM education was that "Far too many students are blocked from opportunities to master STEM because of false assumptions about aptitude" (Drew, 2015, p. 30).

### **Gender**

In the classroom, many educators are cognizant of the methods and classroom tools required for engagement. In an effort to avoid miscommunication between teacher and student, student distraction is often focused upon, the steadfastness of instruction is adjusted, potential educator bias is reviewed, and student confidence is focused upon (Einarsson & Granström, 2002). A TedTalk called *Teach girls bravery not perfection* by Saujani (2016) reiterated the differences between student confidences when regarding the teaching and gender in the classroom:

Most girls are taught to avoid risk and failure. We're taught to smile pretty, play it safe, get all A's. Boys, on the other hand, are taught to play rough, swing high, crawl to the top of the monkey bars and then just jump off headfirst. And by the time they're adults, whether they're negotiating a raise or even asking someone out on a date, they're habituated to take risk after risk. They're rewarded for it... In other words, we're raising our girls to be perfect, and we're raising our boys to be brave. (2:21)

This quote brings forward the ideas of socialization. Aelenei, Darnon, and Martinot (2017) explored the idea of gender socialization. Students portray a gender role that they are taught as they grow (Aelenei et al., 2017). For instance, gender was explained as “boys are socialized to endorse the self-enhancement values more than the self-transcendence values, whereas girls are socialized to endorse the self-transcendence values more than the self-enhancement values” (Aelenei et al., 2017, p. 565). Self-enhancement values are described as enhancing educational goals whereas self-transcendence values are described as outward effects on society (Aelenei et al., 2017). Aelenei et al. (2017) continued to explain that schools do a fair job of creating an equal learning environment, however, male students are socialized in a different learning perspective where male students focus on themselves and make comparisons between others (Aelenei et al., 2017). Brass, McKellar, North, and Ryan (2019) shared how comparisons can bring about social worries. Upper elementary and middle school students were surveyed regarding their social and academic worries (Brass et al., 2019). Female students reported greater amounts of academic worry as they continued through the school year and also showed much higher social worry throughout the school year as compared to their male counterparts and may suggest additional attention from the educator (Brass et al., 2019). Educators may need to be aware of these differences in the classroom, so they are more equipped to build relationships with all students.

### **Gender Bias in Science, Technology, Engineering, and Mathematics**



Friedman (2007) shared with his family how things had differed from when he was younger to the times of today:

When I was growing up, my parents used to say to me, ‘Tom, finish your dinner—people in China and India are starving.’ My advice to you is: Girls, finish your homework—people in China and India are starving for your jobs (p. 237).

Competition for STEM careers has increased over the years, especially regarding positions for women.

However, there are still some despairing issues with gender bias in STEM (American Association of University Women, 2010). Women make up only 28% of science researchers worldwide (Farrell & McHugh, 2017). Stereotypes have formed regarding differences in gender in the areas of STEM. For instance, “STEM careers are often stereotyped as being incompatible with the communal goals commonly valued most by women” (Farrell & McHugh, 2017, p. 80). At the end of middle school, 39.5% of males and 15.7% of females are interested in entering STEM careers. By the end of high school, 39.7% of males are interested in STEM careers whereas only 12.7% of females hoped to continue in a STEM profession (Sadler, Sonnert, Hazari, & Tai, 2012). The male statistics show a slight increase in interest while the female statistics show interest steadily declined. Some students feel that STEM areas are only for the smartest students and out of fear of failing, choose to avoid STEM areas due to the anxiety or issues that arise when a student performs poorly (Farrell & McHugh, 2017). Women are more involved in certain STEM areas like biology; however, are less represented in areas of

engineering, computer technology, and physical sciences (Cheryan, Ziegler, Montoya, & Jiang, 2017).

With this disparity in STEM areas, Han (2016) explained that the gender gap is observed most directly at the eighth-grade level and that this is the most significant predictor of student STEM interest. Wang and Degol (2017) explained that “Throughout childhood and adolescence, gender differences in STEM careers that reflect differences in interests reach back as far as early adolescence and are reinforced through a continual process of decision making, experiential outcomes, and expectations of others” (p. 124).

The experiences that students gain during their early to middle school years “may serve to reinforce these gender gaps in cognitive performance over time” (Wang & Degol, 2017, p. 122). For the middle school student, such experiences exist as STEM programs for girls or girls only STEM clubs. Confidence grows from work well done when regarding STEM learning (Grossman & Porche, 2014). Young girls in fifth or sixth grade shared that they lost their confidence in math and science just as they were starting or moving into middle school (Pajares, 2005). Similarly, many young girls lose interest and engagement in the middle school learning environment, no longer engaged by STEM focuses (Grossman & Porche, 2014).

The learning environment that middle school students are in is organized by performance-based goals instead of mastery goals, as is the case in elementary school (Wang & Degol, 2017). While focused on performance-based learning, students have opportunities to work with their peers. When working with peers, compatibility, and abilities are evaluated and compared. Rueger, Malecki, and Demaray (2010) explained that both young women and men receive similar levels of support from parents/guardians

and teachers, however, young women focus upon support from peers at a higher level than their male counterparts. Rueger et al., (2010) explored how “support from parents and the general peer group, i.e., classmates, was a robust predictor of adolescent outcomes over time, with classmates’ support consistently related to outcomes for boys but not girls” (p. 59).

Grossman and Porche (2014) explained that “Adolescents who experience STEM-related discrimination or stereotyping may question their own abilities or compatibility with STEM study and therefore may be reluctant to explore or pursue these areas” (p. 700). Along those same lines, the culture, community, and surroundings of a student impact the educational interests of students (Cheryan et al., 2017). Grossman and Porche (2014) suggested that middle school students’ engagement and interest in STEM areas are also shaped by their socio-cultural influences, including the environment in which they learn. From Cheryan et al. (2017) the family socio-cultural influence can discourage females in STEM and may also have less effect on males in STEM. Cheryan et al. (2017) explained:

Discrimination can discourage girls’ and women’s participation in STEM.

Sixth-grade girls whose mothers believe that they are less likely to succeed in math-related careers are significantly less likely to choose physical science or computing careers as young adults whereas mothers’ perceptions of their son’s abilities have no relationship to their choice of these career (p. 18).

With these gender disparities in focus, a focus upon STEM areas is necessary.

There are two main theories that exist regarding the interest and engagement in STEM fields for women. Wang and Degol (2017) explained that expectancy-value theory suggested that young women are not as inclined to focus on STEM areas “due to their relatively lower math and science expectancies and values in comparison with men” (p. 120). The second theory focused on the mindsets of women. The mindset theory denoted that women “are more susceptible to reduced math performance in the context of endorsing a fixed mindset in math ability” (Wang & Degol, 2017, p. 120). A deeper focus into the STEM socio-emotional and socio-cultural influences are needed to ascertain why different motivations of interest and mindsets exist. Wang and Eccles (2013), shared that young women maintain a higher sense of engagement over that of their counterparts and that this suggests that gender and student engagement is unclear and necessary to study.

Gender bias in STEM is a needed focus of this study. The exploration of students and their interests and engagements in STEM areas is necessary. The different socio-emotional interests and socio-cultural influences that each gender had, may show connection or disconnection to a students’ participation in STEM.

### **The Future of Science, Technology, Engineering, and Mathematics**

Archer, Dawson, DeWitt, Seakins, and Wong (2015), identified the need for STEM learning as:

Imperative to improve (widen and increase) participation [because it] reflects both national economic concerns, namely to ensure a sufficient talent pool and supply of future scientists, and social justice concerns, to promote equity and ensure a scientifically literate general population who

can be active citizens within a scientifically advanced contemporary society (2015, p. 1).

Across many nations, there is a need and concern to fill STEM fields. Researchers have conducted studies to correlate student learning with the potential for filling future STEM fields. A longitudinal study conducted by Tai, Liu, Maltese, and Fan (2006) explored the likelihood of students earning science focused STEM degrees based upon mathematical and science scores on aptitude tests taken in eighth, tenth, and twelfth grade. The study revealed that students who scored highly on aptitude assessments were 1.9% more likely to receive a life science bachelor's degree and 3.4% higher for physical science degrees (Tai et al., 2006). The percentages of students embarking upon STEM areas is low. Concerning to many is the fact that only 5.2% of students were likely to receive life science and physical science bachelor's degrees (Tai et al., 2006). STEM education separates into two paths of learning post-elementary level which serve to engage students in STEM. For instance, sixth-grade students may learn earth sciences, seventh-grade students may learn life sciences, and eighth-grade students may focus on chemistry and physical sciences. Students also have learned micro to macro levels, integrating all contents throughout the three years of middle school. Depending on teacher experience in the various content areas, the organization of STEM learning can serve as an opportunity for engagement in STEM.

### **Middle School Education**

Education has gone through many types of reform. DuFour and Eaker (1998) suggested a need for change in education that would “make the educational system a learning organization — expert at dealing with change as a normal part of its work, not

just in relation to the latest policy, but as a way of life” (p. 24). This quote by DuFour and Eaker suggested that the United States educational system needs to transform the goals of meeting society’s needs by changing methods of instruction.

## **History**

In the past, schools were considered general institutions of public welfare, so they attempted to accommodate students who were considered “backward” and “those with physical disabilities” (Spring, 2014, p. 285). Then schools transitioned and were modeled to meet the needs of corporations (Spring, 2014). DuFour and Eaker (1998) shared that “If schools want to enhance their organizational capacity to boost student learning, they should work on building a professional community that is characterized by shared purpose, collaborative activity, and collective responsibility among staff” (p. 24). Many educators have stressed the importance of professional learning communities explained that without this opportunity to collaborate, educators would teach dissimilar content, methods, and may not expand on the positive inspirations and engagements of students.

In the 1980s, middle schools separated from junior high models, losing the vocational aspect of learning and instead students moved towards team building and socio-emotional focuses (Spring, 2014). It is suggested that the 1980s posed a time when the educational setting for students was not streamlined and up to the learning needs of students (Spring, 2014). The Carnegie Council on Adolescent Development (1989) set parameters around the idea of a reorganization focused on student-centered learning to allow for critical autonomous thinking. This method connected a sense of belonging to build stronger connections between students and adults. Spring (2014) shared that this refocus upon the student came in part to a need to focus upon standardized testing and

behavior objectives. In the 1980s, the National Middle School Association argued that the middle school needs to provide an education that meets the needs of all adolescent learners (Olofson & Knight, 2018).

Thus, a new practice of teaching would need to be assembled. Panorama Education (2018) has suggested that behavior goals need to be a priority in student learning, in addition to content standards and goals. Adolescent students need development in the areas of “physical, intellectual, emotional, physiological, social, and moral development” (Olofson & Knight, 2018, p. 1). Olofson and Knight, (2018) explained that “Recent research has suggested that middle schools that adhere more closely to the middle school model are more successful than those which do not” (p. 1). Olofson and Knight (2018) noted the importance of having experienced staff at the middle school because “... the presence of educators who are well prepared to teach students of this age, a supportive and diverse community, a schedule that allows for exploration, and adequate funding to help build capacity and support teaching and learning conditions” are idea for building student interest and engagement (p. 3).

### **Engagement**

Research has shown that the middle school years show declines in students’ interest and engagement in science (Lee et al., 2016). Wang and Eccles (2013) suggested that students should be actively engaged through engagement as students need to receive the knowledge and skills necessary to be successful in post-secondary learning.

Motivation is a key factor in STEM education because it drives the interest of students in their learning and their pursuits to continue to study STEM areas in the future (Archer et al., 2015; Britner & Pajares, 2006; Lee et al., 2016; Pajares, 2005). As the push for more

authentic science practice increased through the use of the Next Generation Science Standards, students learned to build upon their self-efficacy in science which may increase their motivation and engagement in STEM (Lee et al., 2016; NGSS Lead States, 2013).

Student engagement has been a topic of in-depth research. While researchers have various definitions of engagement, many have suggested that it is the connectedness that students have towards their learning and even towards the utilization of feelings and senses in activities for their education (Harper & Quaye, 2009; Lee et al., 2016). According to Wang and Eccles (2013), research has not shown “whether various aspects of the school environment influence the behavioral, emotional, and cognitive engagement differentially and whether the associations between the school environment and engagement are mediated by more fundamental motivational beliefs within the student” (p. 12). Wang and Eccles (2013) suggested that engagement in school requires an integral motivational focus in addition to the needs of the student. For several STEM content areas, collaborating with others, utilizing senses, and feelings are precisely the tools used to inspire engagement in STEM learning. Many educators were taught to follow Bloom’s Taxonomy to ensure that their students were reaching the highest levels of understanding through engagement and motivation (Bloom, 1956). The newly adopted Next Generation Science Standards (NGSS) build upon real-life science in an effort to connect and engage students to science topics.

As elementary students move into middle school, there is noted a decline in motivation and engagement (Martin, Way, Bobis, & Anderson, 2015). For instance, as upper elementary students moved into middle school settings, by grade seven or grade



eight, there was a deep decline in interest for mathematics (Martin et al., 2015). It is suggested that this motivational decline has to do with the engagement of students in the classroom (Lee et al., 2016; Martin et al., 2015). Even more so, “classroom and home influences significantly related to achievement via engagement” (Martin et al., 2015, p. 202). The effect of the home and classroom directly work with or against student confidence.

### **Student Confidence**

Noddings (2015) has stated, “As most subjects are taught today, students have little reason to remember what they have learned” (p. 235). Educators continued to promote STEM. However, there has been an issue with teachers relating to students. This disconnect failed to emphasize the grit (Duckworth, 2016) and the abilities to build growth mindsets (Dweck, 2008) of a capable STEM learner. As Mark Edmundson (2002) explains, the teacher who made the largest influence in his life shared “kindness [that] is often a balm to students, particularly the bullied and the misunderstood. There are few of us, especially in adolescence, who can’t benefit from a dose of pure benevolence” (p. 11).

Noddings (2005) promoted this caring and relational type of educator through her ideas of the ethics of Care Theory. She suggested that “To care means to respond to needs, and needs do not stop (or start) at the schoolroom door (Noddings, 2005, p. xxii). Noddings (2005) explained that if this idea of caring is not shown students will feel alienated from their schools and schoolwork because they think the adults do not care. As Noddings and Lees (2016) has shared, “we should put great emphasis on the teacher-student relationship, within or outside formal schools, and how it can be developed and

maintained” (pp. 1-2). Relationships are crucial to student engagement and motivation. It may even be how student interest may increase towards STEM fields.

It is through caring relationships that students learn to trust their educators and to enhance student interests (Noddings, 2005). Noddings (2015) argued, “A major purpose of teaching is to inspire the interest that activates intellectual processes, and those processes support the acquisition of further knowledge. Process and content are interactive” (p. 233). To help increase these interests, “Classrooms should be places in which...wonder and curiosity are alive, in which students and teachers live together and grow” (Noddings, 2005, p. 12). Educators who build the necessary relationships with their students by showing “how to care by creating caring relationships with them” along with building “attitudes and mentalities [that] are shaped by experience” can help change education (Noddings, 2005, p. 23). This change of methodology used in educating students may increase engagement and student interest.

Devis-Rozental (2018) shared that relationships help “Students feel valued, supported and encouraged will do the best they can” (p. 167). Wang and Eccles (2013) explored the support found in schools. Educators who utilized clear expectations and provided feedback allowed for students to be more behaviorally and emotionally engaged, suggesting that a school structure organized around an active emotional and behavioral engagement would be best suited for students (Wang & Eccles, 2013). Additionally, connecting through individual expressive thoughts helps strengthen the behavioral and emotional bond of learning between an educator and student (Noddings, 2005; Wang & Eccles, 2013). Providing learning opportunities that are autonomous to real work events gives students a more significant experience and a higher level of

satisfaction which may contribute to emotional and behavioral engagement (Bardach, Lüftenegger, Yanagida, Schober, & Spiel, 2019; Wang, Eccles, & Kenny, 2013). It is through these real-life approaches that students have embarked upon new discoveries and interests in the world of STEM education.

### **Socio-Emotional Interest**

School districts across the United States argued for the necessity of socio-emotional learning (SEL) of their students. SEL helps to promote necessary competencies for students (Lawson, McKenzie, Becker, Selby, & Hoover, 2019; Panorama Education, 2018). SEL provides students with effective learning strategies. According to Coskun (2019), “Affective learning helps students establish positive relationships with others, adjust to a social environment, and have improved well-being. Affective learning involves three processes consisting of (a) stress responses, (b) moods, and (c) emotions” (p. 764). For students, SEL may help with building more resourceful classrooms that “function more effectively and student learning increases when children can focus their attention, manage negative emotions, navigate relationships with peers and adults, and persist in the face of difficulty” (Jones et al., 2017, p. 50). Jones et al. (2017) shared that SEL programming helps change, engage, and positively influence students’ lives. Furthermore, “SEL interventions give children opportunities to learn the life skills they need for successful development” (Greenberg et al., 2017, p. 16). Through a focus on the resources to help individuals deal with their emotions, self-regulate, and continue through difficulty, a change in the educational outlooks of individuals in STEM, may occur. As

seen in Figure 1, the importance of grit, self-efficacy, and social-awareness helps to produce potential student success in the STEM fields.

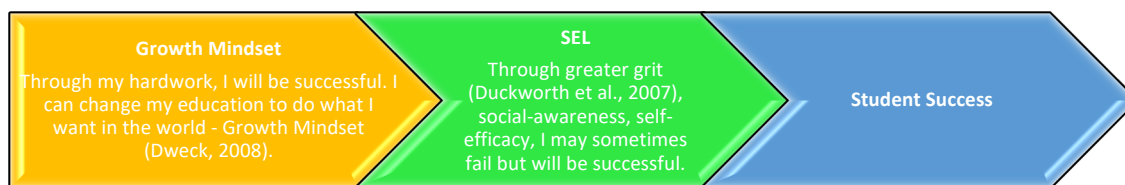


Figure 1. The Relationship Between SEL for Success (Duckworth et al., 2007; Dweck, 2008).

According to Haley et al. (2017), SEL interventions promote well-being in students, showing positive well-being and outcomes for students. Utilizing SEL lessons in the school setting can help prepare students to be well equipped for their futures. Instead of students giving up quickly, SEL interventions and learning help to prepare students through practiced skills. Haley et al. (2017) also explained that regardless of racial and socioeconomic grouping, students still maintained positive influences from the various SEL interventions promoted at school. Devis-Rozental (2018) clarified the need for SEL interventions through all academic levels to de-stress students and help them to build social connections to peers.

CASEL (2018) laid out the various competencies necessary for success in SEL programming. Those competencies are self-awareness, self-management, social awareness, relationship skills, and decision making (CASEL, 2018). Each of those areas is important in maintaining and encouraging the necessary mindsets and behaviors to be successful in post-secondary STEM areas. Regarding SEL competencies, Lawson et al. (2019) explored social awareness and found that a lesser amount of emphasis is focused

on the socio-cultural engagement and influences for students. That study proceeded to involve those socio-cultural influences to connect to the social awareness piece of engagement in STEM (Lawson et al., 2019).

The education setting is not the only locale that utilizes emotional support for its employees. The need and benefits of emotional support have allowed for various professions to work to educate their staff on socio-emotional learning. In a study by Sarabia-Cobo et al. (2017), an exploration of how nursing professionals utilized emotional learning training was examined. In that study, nursing professionals reported a positive effect of socio-emotional learning after the workshop noting the strength in “Expressing one’s own feelings and listening to the feelings of others in the workshop [which] required communication skills, emotional control and empathy” (p. 97). The results of Sarabia-Cobo et al. (2017) study confirmed that socio-emotional training makes a difference in the emotional health of nursing professionals, helping them to become better equipped with skills to be successful in handling stressful situations.

For this study, I focused on the following areas of SEL at the middle school level. Grit is the main focus of student achievement, and many research articles have explained the ideas involved in student learning. Mindsets also drive engagement and interest and through various research have shown connectivity to a student’s success. Self-efficacy is another area of focus, stemming from Bandura (1997) and Britner and Pajares’ (2006) research. Social-awareness is a collaborative skill learned and practiced by students to help ensure success in post-secondary STEM areas.

## **Grit**

Albert Einstein has said, “It’s not that I’m so smart, it’s just that I stay with the problems longer” regarding perseverance (Ralston, 2010, p. 28). There is also a famous quote from Thomas Edison, reported by Forbes (1921), which showed the determination Edison needed to create and invent:

After we had conducted thousands of experiments on a certain project without solving the problem, one of my associates, after we had conducted the crowning experiment and it had proved a failure, expressed discouragement and disgust over our having failed to find out anything. I cheerily assured him that we had learned something. For we had learned for a certainty that the thing couldn’t be done that way, and that we would have to try some other way (p. 89).

In application to the student learning process, the longer a student works on and tries to solve a problem, the higher the chance of success. Educators are often faced with many questions throughout their lessons. One of the most challenging questions educators ask themselves is why some students comprehend information where others continue to struggle and seemingly give up. Duckworth and Gross (2014) explained that “Prospective longitudinal studies have shown that grit predicts the completion of challenging goals despite obstacles and setbacks” (p. 2).

Duckworth completed several pivotal research studies exploring how grit affects the success of students through explaining that the more grit an individual has, the higher the success (Duckworth, 2016; Duckworth & Gross, 2014; Duckworth, Kirby, Tsukayama, Berstein, & Ericsson, 2011; Duckworth et al., 2007; Duckworth & Quinn, 2009). The amount of grit that a student brings to the classroom may be able to explain

how successful the student will be in the class (Flanagan & Einarson, 2017). STEM requires some of the most focused and content-driven individuals due to the challenging comprehension of math and science-minded foci. As such, solving problems as Albert Einstein had mentioned, may require grit to be the key to the success of students (Duckworth et al., 2007; Ralston, 2010).

Grit is an area that many school districts have researched in the hopes of producing successful students (CASEL, 2018; Panorama Education, 2018). Many school district officials assessed the SEL of their students and realize that grit is an area of concern. Research from Park, Yu, Baelen, Tsukayama, and Duckworth (2018) has shown that students who worked under the mastery of their school “were more likely to demonstrate greater passion and perseverance for long-term goals, and this in turn predicted earning higher report card grades” (p. 125). It is even suggested that “educators implicitly or explicitly signal that they value effort and goal perseverance, which subsequently leads students to adopt these beliefs and exhibit more grit themselves (Park, et al., 2018, p. 125). Regarding engagement for student success, research has shown that a student’s grit relates directly to their engagement in the classroom (Von Culin et al., 2014). The mindset and behaviors that drive an individual student to be successful may be focused upon the individual student’s grit and working mindset (Von Culin et al., 2014).

### **Mindsets**

Dweck researched the mindsets of students over many years. She explained that there are two mindsets (Dweck, 2008). The first type of mindset is fixed; this mindset suggests that students do not believe they can change their skill levels (Dweck, 2008).

For instance, if a student is struggling in math, they will continue to struggle, and it is not necessary to push oneself harder as it will do no good. The second mindset is called a growth mindset (Dweck, 2008). In this thinking, a student sees the hard work and perseverance as contributing to future successes (Dweck, 2008). When some students struggle with math, this mindset suggests that the student should put forth more effort to understand where and why they are struggling so that they can overcome this hardship to become more successful in the future. Together, mindset and grit work to provide success in a student's learning.

### **Self-Efficacy**

Bandura (1997) referred to self-efficacy as “one's belief in his or her abilities to achieve certain outcomes” (p. 3). According to Britner and Pajares (2005), “Self-efficacy has been found to be a strong predictor of academic achievement, course selection, and career decisions across domains and age levels” (p. 485). Students who have a high sense of self-efficacy seem to have the will to complete difficult tasks in STEM, work hard to see success, and even have the mindsets to push past problems, issues, and errors (Britner & Pajares, 2006). Students with weaker self-efficacy will avoid working through STEM tasks and may even avoid the tasks altogether (Britner & Pajares, 2006).

Martin et al., (2015) explained that “Mathematics self-efficacy and valuing were consistent predictors of mathematics engagement shifts, with higher self-efficacy and valuing associated with increases in engagement across the year” (p. 228). Helping students to realize their successes or by supporting students in times of need, helped to build self-efficacy of mathematics students (Martin et al., 2015; Pajares, 2005). The necessity of positive self-efficacy relates directly to the potential for future success in



STEM (Britner & Pajares, 2006). According to Britner and Pajares (2006) “Research on the sources of self-efficacy beliefs will provide influential adults in these young peoples’ lives with information needed to support optimal development of science self-efficacy beliefs” (p. 489).

Bandura (1997) suggested that students build their self-efficacy from engagement in tasks and through the experiences they undergo. For instance, when a student is engaged and completes STEM-related tasks that are successful, the student builds upon the experience and forms a mindset to realize that they are capable of success related to STEM (Bandura, 1997). Self-efficacy may help the individual overcome challenges as the student realizes that successes can happen and builds a positive mindset. Another way that students grow with their self-efficacy is through vicarious observations (Bandura, 1997). Vicarious observations are also important to the socio-cultural influences of students. Observations that are made by students while interacting with parents/guardians, community, or peers can help drive interests and engagement (Bandura, 1997). The last focus of Bandura’s self-efficacy shared the mental states of the individual (1997). A student with more considerable amounts of anxiety or low self-esteem may struggle regarding their self-efficacy when viewing potential STEM opportunities (Bandura, 1997).

### **Social-Awareness**

Students come into the classroom as active learners or as passive learners. Many educators are concerned about the passive learners. Peters-Burton and Mattietti (2017) have shared that “Passive learners who blame their failures on external, uncontrollable sources, such as ‘I’m just not good at science’ or ‘Mathematics is too hard for me’ or

most destructively, ‘The teacher just doesn’t like me’” will struggle in classes (p. 273). These learners have built up ideas of failure or separation from learning, which can hurt their engagement, grit, and self-efficacy. Dweck (2008) in addition to Peters-Burton and Mattiotti (2017) have explored this mindset and have suggested that helping students comprehend how STEM fields work may increase the number of students in those fields. As Peters-Burton and Mattiotti (2017) explained in the following quote, social-awareness is the skill needed to help change the mindsets of some students into STEM fields:

Awareness of learning can be the keystone for student understanding of how science disciplines operate and for identifying with the way scientists, technologists, mathematicians, and engineers work. Student social-awareness of learning is a transferrable skill that builds confidence in STEM learning so that students are free to pursue any field of interest without facing barriers due to lack of educational experience. (p. 289)

Peters-Burton and Mattiotti (2017) justified that students who understand themselves as motivated students have a greater likelihood of looking towards the STEM fields as areas of opportunity in the future. Educators can help build their students’ social-awareness by making STEM more tangible (Peters-Burton & Mattiotti, 2017). In the classroom, students want to feel successful. Peters-Burton and Mattiotti (2017) explained that when students realize success is obtainable, they are more inclined to try for risks, and these risks may coincide with ideas for success in STEM.

Through the ability to build an awareness of how a student thinks, content knowledge in STEM can improve learning (Peters-Burton & Mattiotti, 2017). Educators who build relationships and engagement into STEM are allowing for the interest and

creativity to be strengthened by their students. This may create new interest in STEM learning for students. Building social-awareness helps students feel more comfortable, allowing for risk in the classroom, and fosters excitement for learning new topics in class (Peters-Burton & Mattietti, 2017).

Socio-emotional competence research shared the necessity for schools to utilize the CASEL learning principles in the classroom (CASEL, 2018; Dweck, 2008; Panorama Education, 2018; Peters-Burton & Mattietti, 2017). In this study, focusing on socio-emotional competence at the middle school level does not reach all aspects regarding interest and engagement in STEM. Therefore, in an effort to understand the necessary decision-making learned behaviors and skills for a successful post-secondary STEM future, involving socio-cultural influences and engagements of students is essential.

### **Socio-Cultural Influence**

Students rely on their parents/guardians and community to guide them and help them grow. Children's emotional development may even be derived by the values, behaviors, and attitudes of their families, neighbors, friends, peers, and the community in which they live and grow (Bhargava & Witherspoon, 2015). Even more so, children are influenced by the outlooks, ideas, and actions of their families, peers, and the communities (including teachers) in which they live and learn (Bhargava & Witherspoon, 2015).

Another vital idea to address is the fact that students all learn differently. Students are influenced by their cultures. Pinxten (2015) discussed how the upbringing of a child may cause children to learn to count differently. For instance, using fingers and toes as tactile learning versus the spatial visual learning of images changes through differing

cultures. Pinxten (2015) continued to explain that “mathematics education implies a choice about society, about democracy or power imbalance...if one allows for different notions, procedures, and problem formulations, to begin with, the chances increase for all those children who come with a different cosmology or mindset” (p. 98). This research suggested that the more opportunities for a child to learn, the more success the child may be surrounded with (Pinxten, 2015). Likely, the differences that each child brings to the classroom may help enrich the classroom. For instance, Upadhyay et al. (2017) designated that “Students can actively utilize these rich sources of knowledge in science classrooms and proceed to frame science learning through these experiences” (p. 2528). In particular, STEM learning allows for students to collaborate, learn from the teacher and peers while gaining the experiences of people in the community. This type of learning can help change student’s mindsets but requires the socio-cultural impact of educators, peers, parents/guardians, and extracurricular learning.

### **Educator Influence**

According to Lei, Cui, and Chiu (2018), “As students spend much of their time with their teachers in school, teacher support can be vital to students’ academic development, including not only learning outcomes but also affective or emotional outcomes” (p. 1). An educator’s role is to present and engage students in the content they are teaching. However, there also may be a missing relationship between student and teacher. Sullivan, Hegde, Ballard, and Ticknor (2015) expressed that if there is a detachment between teacher and student, particularly involving cross-cultural relationships, a disconnect can form. This disconnect may stem from “language barriers, cultural differences, and time” (Sullivan et al., 2015, pp. 343-344). Educators may

struggle with adapting to these differences and seeking out the support to reach their students. Additionally, Ebadi and Gheisari (2016) noted that educators benefit from a focus on critical reflection. This critical reflection is particularly helpful when reevaluating relationships built with their students. Once these reflections occur, teachers are able to reshape their classroom practice for the better and therefore create a more positive socio-cultural connection in the classroom (Ebadi & Gheisari, 2016).

For students, teacher support is necessary for success. Lei et al. (2018) illustrated that “students with more teacher support have more enjoyment, interest, hope, pride, or relief [positive academic emotions] (PAEs); or less anxiety, depression, shame, anger, worry, boredom, or hopelessness [negative academic emotions] (NAEs)” (p. 2). Through the research of Lei et al. (2018), students suggested that the support received by their teacher directly affected their academic goals. Students continued to explain that successful goals were created through the help of strong relationships with educators, particularly when the educator shared a similar culture, age, and gender (Lei et al., 2018). Also, Archer et al. (2015) stated that students who had the positive motivation to study difficult areas in STEM continuously, and who were guided by a close educator or family member, did indeed help drive the student’s decision to study STEM areas of focus in college.

### **Peer Influence**

According to Britner and Pajares (2006), “Students who are told by significant others that they have the ability to master new or difficult science tasks are more likely to persevere in the face of challenges and mobilize the effort needed for efficacy-building successes” (p. 495). Peer association and connectivity becomes essential to the middle

school student. The influence of middle school peers can be more critical to student engagement than the parents or guardians that the student has grown up with, particularly for female students (Curlee, Aiken, & Luthar, 2018; Rueger et al., 2010). Due to this information, the connectivity that students have with their peers becomes even more important for students when selecting classes in middle school or through engagement and interest for success in the STEM courses. In research by Curlee et al. (2018), it was explained that the number of students who focus on positive or prosociality relationships between peers was not only reporting higher than average psychological adjustments but also scored higher on SATs. This reiterates the peer connection between students.

Peer encouragement is important. However, encouragement must be realistic and authentic (Britner & Pajares, 2006). It is suggested that if adults and educators model the correct prosociality behaviors for their students, students will be more likely to understand the appropriate expectations in those relationships (Curlee et al., 2018). Curlee et al. (2018) rationalized that prosociality focuses upon a positive reflection of the community, friendship, and caring, which allow for social behavior and academic accomplishments to be favored. Britner and Pajares (2006) reported that “Encouraging students to attempt tasks significantly beyond their present abilities and knowledge has the potential to lead to disconfirming failures that diminish self-efficacy rather than enhance confidence” (p. 495). For instance, a student’s success may be directly related to peer interaction. If a student notices higher-achieving peers are not successful in a STEM activity, the likelihood of that student giving up becomes higher (Britner & Pajares, 2006) which promotes a disconnect from the learning. Peer influence is significant to the middle school student. The peer influence that students come across daily is more likely

to hinder self-efficacy than to help it grow (Britner & Pajares, 2006). With the necessity of studying STEM areas, the prosociality between peers is necessary to help students realize their potential and help to build the perseverance and grit to be successful in STEM.

### **Home and Parental/Guardian Influence**

For some children in elementary school, they study careers of parents/guardians and community individuals. Children in elementary to middle school live vicariously through family members (Bandura, 1997). For instance, students who have family members who work in STEM-related fields are more likely to focus upon those same fields in the hopes of working in careers similar to their family members as long as they have observed positive experiences (Archer et al., 2012; Curlee et al., 2018; Eccles & Wang, 2016).

When students observe their parents' successes, this proves to a student that they are also able to complete the successes of their parents (Bandura, 1997; Buchanan & Selmon, 2008). Buchanan and Selmon (2008) explained that "parents' achievements at home and in the workplace may contribute to self-efficacy in their children" (p. 823). This may connect to the working environment and the practices of parents. Children are fantastic observers of the world around them and when they observe a parent struggling, they may focus on that detail. The same goes for when a child observes successes from a parent/guardian. For instance, when young girls have working mothers, they grow to expect less family time with their families (Buchanan & Selmon, 2008). This is due to the familial observations they experience with their families. Buchanan and Selmon (2008) demonstrated that young men with working mothers realize that they must spend more

time with their families to fulfill the needs of the family. This comes from experiences and observations of working mothers. Knowing this valuation of time can be very important to individuals interested in the STEM fields. According to Eccles and Wang (2016), one of the most negative associations with the STEM field is the lack of time available to be with family when focused on one's careers.

### **Extracurricular Activities**

At the middle school level, the need to be involved is important. School districts across the nation suggest that students join extracurricular activities to become involved. Besides being involved in activities with peers, there are suggested informal learning skills that take place in extracurricular activities for students (Zhang & Tang, 2017). In some STEM-related extracurricular activities, students can converse with other students regarding STEM informal learning in a person's daily life. This helps to form a STEM culture that students can learn from (Archer et al., 2015). Middle school students benefit through participating in extracurricular activities through prosociality between peers and the opportunity to gain additional informal learning (Curlee et al., 2018; Zhang & Tang, 2017). Unfortunately, many students have found they are too overscheduled and tend to refocus their attention on personal needs instead of being involved in extracurricular activities.

### **Summary**

As the need for STEM professionals continue to rise, the education system is in charge of supplying the types of students who will be successful in the future (Drew,



2015). The future of STEM must employ and encourage both genders equally (Tai et al., 2006). As the Carnegie Council on Adolescent Development (1989) explained, a redesign of the middle school learning environment is necessary for students to be successful. Educators and districts have reformed ideas for middle school education, changing the methods by which they teach and approach student learning (DuFour & Eaker, 1998). A new spotlight on the whole student involving socio-emotional learning, has come into focus for education.

Through the review of this literature, the socio-emotional interest of students has become a primary focus at the middle school level. To create students who are filled with grit, have healthy mindsets, are more self-aware, able to self-manage, gain social awareness, build relationship skills, and allow for decision making, a new focus of learning has been established (CASEL, 2018). Various research studies have pointed out the importance of socio-emotional and socio-cultural learning for students (CASEL, 2018; Panorama Education, 2018; Park et al., 2018; Peters-Burton & Mattiotti, 2017). Research has connected the necessity of a student's success and engagement in the prospect of a post-secondary study of STEM (Peters-Burton & Mattiotti, 2017). As many school districts utilized SEL objectives to help improve student grit, self-efficacy, and social-awareness, correct mindsets are modeled in the hopes of helping students realize their potential in STEM (Dweck, 2008; Panorama Education, 2018).

Research is still needed to embark upon the socio-emotional competence of students and their interests in STEM, particularly at the middle school level. This research is necessitated to show if any gender differences exist allowing for new strategies for educators to use to increase interest and engagement in the classroom.

Research can explore what gender differences are found between the socio-cultural influences of middle school students. Added research is may connect how the socio-emotional interest of students and their socio-cultural influences may influence or deter students from STEM areas. The socio-cultural influence of students, which may be impacted by educator influence, peer, home and parent/guardian inspiration, and extracurricular activities, may share a new perspective into STEM learning for students at the middle school level. This may drive new ideologies into educating the middle school mind, allowing for more exploration into the STEM fields to exist for all students, equally.

### **CHAPTER III**

#### **RESEARCH METHODOLOGY**

For this research, a mixed methodology was used to explore gender differences in the socio-emotional STEM influences of middle school students while also examining the socio-cultural influences of young women in STEM. The purpose of this study focused on the ideas of socio-emotional interest: grit, mindsets, self-efficacy, and social-awareness along with the socio-cultural influences: of educators, of peer influence, of parental/guardian influence, and extracurricular activities to understand the interest or disinterest of students, particularly female, related to STEM learning. I utilized both quantitative and qualitative data to answer the four research questions. Quantitative data were used to answer research questions one and two, whereas qualitative data were used to answer research questions three and four. Johnson, Onwuegbuzie, and Turner (2007) define mixed methods as:

Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration. (p. 123)

The research questions that were utilized for this study are:

- Q1     Are there significant gender differences in the socio-emotional interests (grit, self-efficacy, and social-awareness) of middle school students found through the student survey questions?
- Q2     Are there significant gender differences in the socio-cultural influences of middle school students found through the student survey questions?
- Q3     What socio-cultural perspectives do middle school young women with higher socio-emotional and socio-cultural STEM interests have?
- Q4     What socio-cultural perspectives do middle school young women with lower socio-emotional and socio-cultural interests have?

In chapter three, I examined the philosophical perspective of the socio-emotional and socio-cultural framework with middle school students. I shared my researcher stance. Then I revealed the mixed methodology for this research. The participants, settings, materials, and procedures were explored before data analysis. This chapter serves to frame the reasoning for and how the research that I conducted, occurred.

### **Philosophical Perspective**

Creswell and Plano Clark (2018) explain that researchers should share their philosophical perspectives. Creswell and Plano Clark (2018) explain that “mixed method researchers bring to their inquiry a worldview composed of beliefs and assumptions about knowledge that informs their study” (p. 35). As a mixed methods researcher, the worldview of pragmatism is where I have most directly associated.

As a mixed method pragmatist, my interest was upon the potential change that may stem from the research study. As Creswell and Plano Clark (2018) noted, many researchers, who have embraced pragmatism focus on the questions of their research instead of the various methods utilized to answer the questions of their study. As a researcher, I felt that my questions may help drive change in STEM education reform.

Tashakkori and Teddlie (2016) used Dewey's ideas to explain the importance of pragmatism to the mixed methods researcher:

Dewey's pragmatism can help us to see, for example, that realist assumptions do not necessarily have to go together with an objectivist conception of truth; that intervention plays a crucial role in the ways in which we obtain knowledge; and that because our knowing is always a result of our actions, knowledge can provide us only with information about possible connections between actions and consequences, not with once-and-for-all truths about a world independent from our lived lives (p. 95).

Through the use of my pragmatism viewpoint, mixed method research combined both qualitative and quantitative data to ensure that the data received was data-adequate and that the explanatory sequential analysis helped to find the causes, factors, and correlations that may help research data become useful (Tashakkori & Teddlie, 2016). All in all, pragmatism is the viewpoint that allows a researcher to collect the data that best answers research questions (Creswell & Plano Clark, 2018).

### **Theoretical Framework**

Following the philosophical perspective is the idea of a theoretical framework. Creswell and Plano Clark (2018) defined this as "a general explanation of what the research expects to find in a study" (p. 43). As this is a mixed methods study, the quantitative focus is to test a hypothesis with data whereas the qualitative focus is to explain what was found in the study (Creswell & Plano Clark, 2018).

My theoretical framework was found in the realm of the social sciences. There are three theoretical frameworks from which this research has stemmed from. Those frameworks are gender equality, care theory, and self-efficacy. Those chosen theoretical frameworks approached the goal of understanding the socio-emotional influences and socio-cultural perceptions of young women and their interests in STEM.

Within the gender equality framework, I was curious about the differences found between male and female middle school students regarding their socio-emotional STEM interests and STEM learning. Additionally, I was also interested in understanding the socio-cultural differences that may be present among young women at the middle school level. Known as feminist theory or gender bias, this research viewed gender as a primary focus of analysis and explored the idea that women and men do have differing experiences (Ropers-Huilman & Winters, 2011). This viewpoint was useful when analyzing the STEM perspectives of male and female students.

Care theory is another framework that I explored. Noddings (2005) and Dweck (2008) both acknowledged the importance of reviewing and strengthening the relationship between a student and the educator. This relationship can help focus on the research of how socio-cultural influences may guide students into and away from STEM learning. An important focus of this research was to gather the interests and influences that students in the middle school level have regarding STEM.

Self-efficacy is the third framework utilized in the mixed methodology. Bandura (1997) explored the idea of specialized skills being used as a tool for success. In this research, I was able to collect data to inquire upon the self-efficacy of students and their

interests in STEM. To further review self-efficacy, student gender differences of socio-emotional competency was compared.

### **Theory Verification**

Creswell and Plano Clark (2018) defined the pragmatist worldview for theory verification as being “real-world practice oriented” (p. 34). My perspective that the relationship between an educator and student can influence and drive interest stems from various theorists in addition to my time as a STEM educator. Noddings (2005) placed the highest regard for the relationships between educators and students. It is through this outlook that educators can challenge, gain interest, and understand their students. Dweck (2008) suggested how student mindsets can challenge student success. Dweck (2008) explained both the growth and fixed mindsets of students while also sharing the necessity of growth mindsets for the success of students. Grit and self-efficacy in learning also have become important factors of the growth mindset, pushing students towards perseverance in their learning (Duckworth & Gross, 2014; Duckworth et al., 2011; Duckworth & Quinn, 2009). The mindsets that students come to school with and how they leave are essential in their development of understanding and applying knowledge from the day in middle school. In the middle school setting, socialization is a skill that is developed throughout the student’s career. Having a positive mindset is a skill that will help students be successful in their futures (Gehlbach et al., 2016). Through the examination of socio-emotional influences and socio-cultural perspectives, educators may be able to create healthy relationships needed to help students realize their self-efficacy while building positive mindsets that will successfully help students continue to find interest and grit required for STEM learning. This is focused upon theorists who

believe in the importance of relationships and correct mindsets of students to engage and enhance their learning, particularly into STEM fields (Duckworth, 2016; Dweck, 2008; Noddings, 2003).

### **Epistemology: Practicality**

Epistemology is described as the relationship between research and the data being collected (Creswell & Plano Clark, 2018). In mixed methods research, practicality is the idea of utilizing the best method to address research questions (Creswell & Plano Clark, 2018). In my study, I combined both social science and constructivist viewpoints.

Through these lenses, the research regarding socio-emotional interests and socio-cultural perspectives and how they relate to STEM education was explored. The social sciences lens worked to describe the gender bias that may be found in STEM (Creswell & Plano Clark, 2018). The constructivist lens focused on the thought that there is a significant relationship within “learning and teaching and epistemology” (Adams, 2007, p. 254). A constructivist interprets learning as experiences that are connected with a student’s previous interactions and knowledge, which is then reworked as continued learning (Egbert & Sanden, 2014). For this research, participants’ socio-emotional interests and socio-cultural perspectives are socially constructed to gain a deeper understanding of their engagement and interest in STEM education and future possibilities. Through the use of both the social sciences and constructivist lenses, the research explored the socio-emotional interests and socio-cultural influences of middle school students, particularly female students.



### **Researcher Stance**

Creswell (2007) explains that researchers should share their perspectives that may have influenced the study to clarify their research stance in an effort to establish trustworthiness. My research stance stems from my time in the classroom and my personal experiences as a female in STEM. Merriam (2009) explains that researchers “need to explain their biases, dispositions, and assumptions regarding the research to be undertaken” (p. 219).

My role as an educator is my second career. Before working with students, I worked in a biotechnology company where I synthesized DNA and RNA. I have a cell and molecular biology background in STEM. However, after working with the biotechnology field and feeling underrepresented in my position as a female while also feeling that my work was not contributing to society in the ways that I had hoped, I decided to move towards education. I pursued my master’s in teaching and learning and began teaching middle school science. I choose the middle school level as I was directly influenced by my seventh-grade science teacher into pursuing a STEM focus.

As an educator, I have taught a range of science subjects from earth sciences, biology, ecology, physics, and chemistry. I have also taught mathematics classes, particularly algebra and geometry classes. In each of my positions, I have focused upon the relationships between myself and my students, hoping to create engagement and interest levels that I found when I was in middle school. Often, I was surprised by the amount of engagement and interest that students presented. Thus, my interest in this research subject was created. Relationship building (Noddings, 2005) is incredibly important in helping to facilitate the student and teacher connection that allows for

engagement to occur. However, knowing and experiencing the gender bias in STEM fields, firsthand, I realized a need to change this perspective and help all students, regardless of gender, to realize their potentials and hopefully help guide a student to study and explore STEM careers in their futures.

### **Mixed Methods Design**

In this research, a mixed methods sequential design was utilized to gain knowledge of the socio-emotional and socio-cultural perspectives of middle school students, particularly that of female students. Mixed methodology definitions have changed over time, as has mixed methodology. There are a few definitions for mixed methods research, pending the fields research is conducted in. Plano Clark and Ivankova (2016) explain that there are commonly used terms but that each definition can be used to bring about a new perspective of the mixed methods design.

This study is focused on the area of social science in education. The fundamental definition that Plano Clark and Ivankova (2016) explained for mixed methods is “The belief that research methods should be integrated or mixed building on their complementary strengths and nonoverlapping weaknesses” (p. 4). Johnson et al. (2007) defined mixed methods as “the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration” (p. 123). Creswell and Plano Clark (2018) used four components to explain mixed methodology. Those four components are: to analyze both qualitative and quantitative research data in response to research questions, combining the two forms of

data and the findings, organizing data in a logical method of the study, and then finally framing ideas within theories (Creswell & Plano Clark, 2018).

Using both quantitative and qualitative methods has allowed for my data to be strengthened. Through the use of mixed methods design, I was able to interlace the quantitative questioning along with qualitative interviewing to provide a much more effective design of research. The parallel sides of quantitative and qualitative research were blended to best answer the research questions. Mixed methodology allowed for a mixture of my quantitative and qualitative responses. Even furthermore, mixed methodology also provided triangulation and “is the argument for using mixed methods to obtain more valid conclusions about a phenomenon by directly comparing the results obtained from quantitative methods to those obtained from qualitative methods for convergence and divergence” (Plano Clark & Ivankova, 2016, p. 84). Additionally, through the use of member checking, triangulation of data took place in this research ensuring that logic procedures were followed. In member checking, participants viewed the transcribed data to update responses through a follow-up email. Finally, mixed methodology allowed for the framing of ideas to be well set up for Chapter Five.

Creswell and Plano Clark (2018) explained that the need for mixed methodology might stem from the realization that one source of data is not enough for the research. In this research, I felt that there would be a hole in the data if I had chosen just one method. As Creswell and Clark interpreted, “Qualitative research and quantitative research provide different pictures, or perspectives, and each has its limitations” (p. 8). Quantitative data can be seen as lacking the personal connection to data by missing the voice in data, whereas, qualitative data may be considered to be underprovided because

of the connections the researcher may make to the subjects (Creswell & Plano Clark, 2018). By combining both of these perspectives, I have sufficiently covered the weaknesses of both forms and therefore provided the most in-depth collection of data for the research.

I chose an explanatory sequential mixed methods design. As Creswell (2007) noted, the main reason for utilizing mixed methodology is to study information that will be explored in greater detail. Through using an explanatory method, there was a natural form of reevaluation of data “through qualitative research” more than “initial quantitative statistical results” alone (p. 548). Mixed methods design provided a greater understanding of the research than either quantitative or qualitative can do alone (Creswell, 2012). To follow up on the quantitative survey results that I used, qualitative methods helped to find a more detailed explanation of the research and ensured that questions were answered for the research.

Creswell and Plano Clark (2018) shared a four-step process that I used in the explanatory sequential mixed methods design (see Table 2). My first step was to utilize the quantitative survey tool to collect the data from the socio-emotional interests and socio-cultural influences of the students surveyed (Creswell & Plano Clark, 2018). Creswell and Plano Clark (2018) suggested that the second step involving the utilization of results. For my second step, I used results to compare male and female student data regarding socio-emotional interests and socio-cultural influences. Here I also compared one open-ended survey question between genders. The results from the quantitative step allowed me to answer research questions one and two. The third step of this four-step process required that I use the qualitative focus of the mixed methods research, in

conjunction with the quantitative focus (Creswell & Plano Clark, 2018). It was at this step that I compared the results of female students; calculating both low and high scores from the survey so that I was able to organize interviews of the female students regarding their socio-cultural influences. This final step involved collecting qualitative data and analyzing results (Creswell & Plano Clark, 2018). The results of the interview questions from the qualitative data answered research questions three and four. At this step of my qualitative analysis, I utilized thematic analysis to interpret my data and discuss it. Glesne (1999) explained that searching for the various themes and the patterns from the qualitative research can be helpful. Data were able to be sorted and coded. According to Creswell and Plano Clark (2018), the final step required that I share and interpret my findings. The quantitative and qualitative sections have been discussed and interpreted so that the qualitative portion was able to help explain the quantitative methods used in this research.

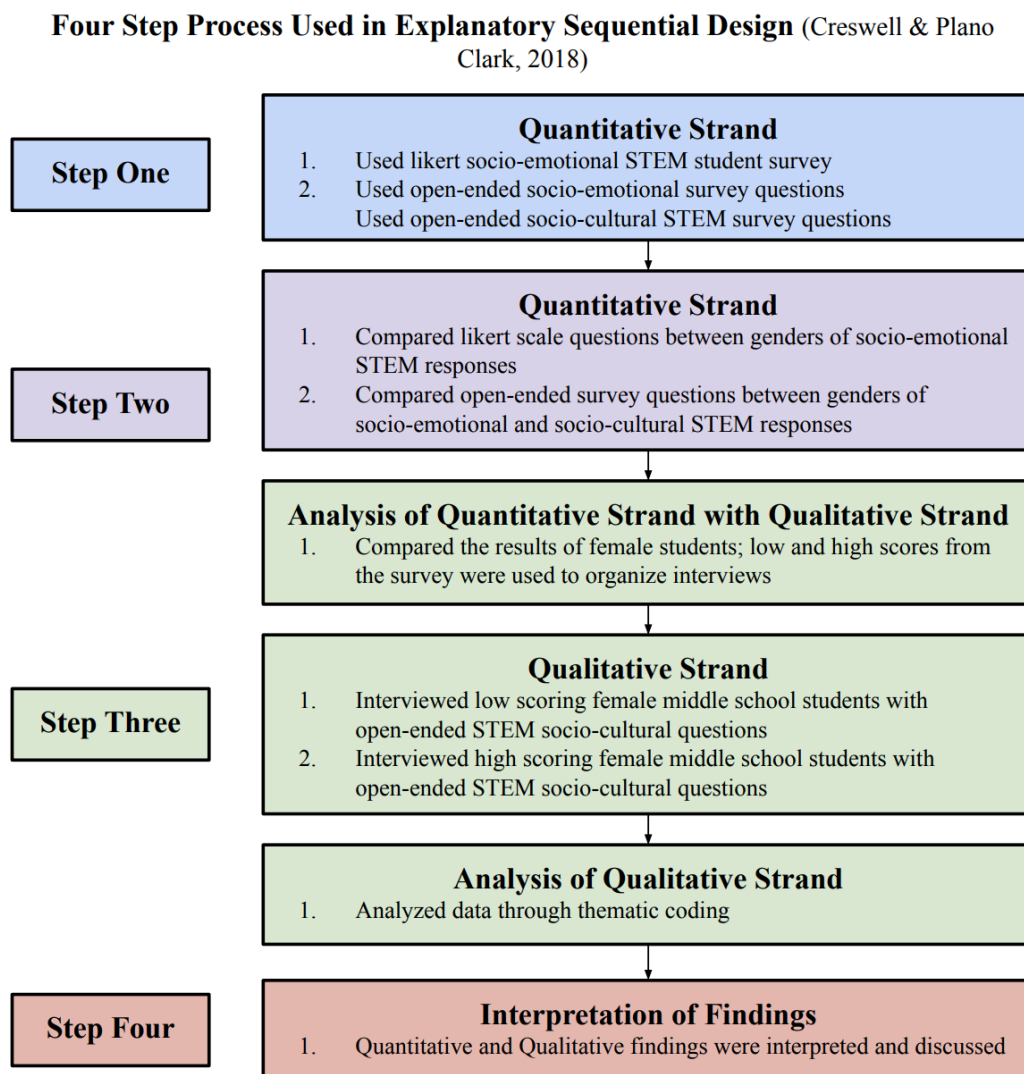


Figure 2. Four step process used for the research of explanatory sequential design for this research.

For this research, mixed methodology helped examine both the quantitative survey tool and open-ended qualitative interviews. Through the use of the quantitative survey, student responses determined the differences between genders regarding student socio-emotional competence of grit, self-efficacy, and social-awareness concerning STEM courses. From Creswell and Plano Clark (2018), the examination of data means to visually review the data while analyzing to define the responses of the research. Creswell

and Plano Clark (2018) suggested that the “quality of scores from the data collection instruments is also examined using procedures to assess their reliability and validity” (p. 213). Following the quantitative analysis, the qualitative thematic coding showed to be necessary. The qualitative view was useful for organizing themes to discovering the differences between low and high scoring female students regarding their socio-cultural influences regarding guidance or misguidance of female students in STEM areas.

### **Participants and Setting**

In total, 159 students were recruited for the research, of which 151 consented to participate in the study. There were three groups of students involved in the research. They were divvied up based upon their grade level. There were 50 sixth-grade students, 67 seventh-grade students, and 34 eighth-grade students who consented for the research. Of the 151 students who consented, 137 fully participated in the survey by answering all questions. There were 41 sixth-grade students, 67 seventh-grade students, and 29 eighth-grade students who fully participated. Of those 137 students, 53% of the students identified with the gender of male whereas 47% of the students identified with the gender of female.

In an effort to inform and recruit as many students as possible, parents/guardians of students in the building were sent an email consent form from the building secretary via the principal’s email address. There were 182 parents/guardians who had consented for their students to participate in the research. I had hoped that parents had discussed the possibility of participating in the research, and through the number of students who had consented to be a participant, it seems that many were interested in the study. Individuals

who participated in the qualitative focus of the research were selected from the individuals who participated in the quantitative focus (Creswell & Plano Clark, 2018).

Initially, I had expected only 75-100 students to participate in the research. However, through a total of 151 students who consented and a total of 137 completed participants, a larger population was formed for the study that was initially predicted. Participants were recruited from one school from a large suburban school district containing more than 25,000 student enrollments, in the Midwest. The total expenditure per pupil at district is greater than \$14,000. The pupil teacher ratio is 15.6. In this district, 26.8% of students qualify for free and reduced lunches. The community of the school has a median home list price of \$384,500. The median home value in Olathe, KS is \$287,750 whereas the county median home value is \$275,000.

This suburban school is the same school that I currently am employed with. The school is made up of sixth, seventh, and eighth-grade students. At this school, two educators per content area teach at each grade level for the core subjects. For instance, there are two science teachers at the seventh-grade level who each teaches 85 to 125 students, making each grade level class roughly 170-250 students large. There are 57 educators who work in this building. Female educators make up 73% of the education staff. Educators identify as 92% White, 4% African-American, 2% Hispanic, and 2% Other.

In this building, females make up 48% of the student body and males make up 52% of student body. Students identify as 74% White, 5% African-American, 4% Hispanic, and 17% Other. In the school, 11% of students are defined as economically disadvantaged and 5% of students utilize English Language Learning programs.



Performance level for National Assessment of Educational Progress (NAEP) shows that 55% of students as proficient in mathematics and 57% of students as proficient in science.

There was an enormous amount of consideration for utilizing the students from the same building that I work at. The primary reasoning was to increase participation and to accrue the likelihood of consent from parents/guardians at the building. As an educator in the school district, parents/guardians were more likely to consent to research, of their students, if they had heard of the educator or if the educator had a positive reflection from administration (see Appendix G). Parents/guardians were more inclined to allow for face to face interviews of their students knowing the educator who was interviewing their student had a positive reflection from administration.

I believe that the reasoning for having the most significant number of participants at the seventh-grade level has to do with the grade level that I teach and collaborate with. Students freely visit the classroom (see Figure 2). Also, as a Science Olympiad coach in the building, I have formed a comfortable and trusting place for students to visit or work, and often there are students whom I do not teach in the classroom.

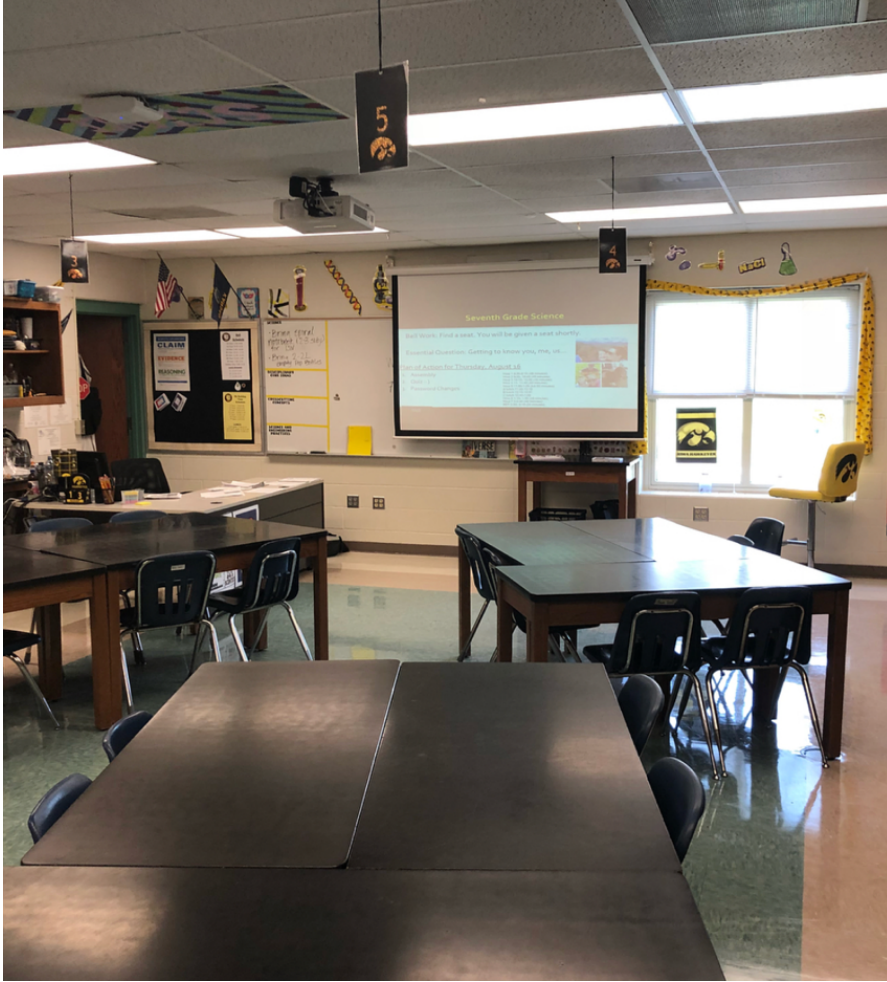


Figure 3. The classroom where interviews took place.

Plano Clark and Ivankova (2016) shared that there are often issues when recruiting and retaining participants for both quantitative and qualitative research. This is due to the increased time commitment and even to the potential loss of interest of participants (Plano Clark & Ivankova, 2016). Taking that into account, the research had to follow a quick timeline in order to ascertain parental/guardian consent, ensure access to students' responses in the survey by student assent, and then to procure the time necessary for student interviews. Plano Clark and Ivankova (2016) also mentioned the additional challenges that could have arisen for the vulnerable population of middle

school students that I had worked with. For instance, I took into account the necessity of reaching out to each student following parent/guardian consent and student assent while also being mindful of the last quarter of the year activities. Often, students have end of year testing, finals, applications into high school programming, and other activities that had to be worked around. Middle schools from this large suburban school district, in the Midwest, utilize an end of day class called academic extension (see Figure 3). I was able to use academic extension time to push out the student assent form, the survey for students, and to interview students one on one. I wanted to make sure that, above all, I was cognizant of participant time.

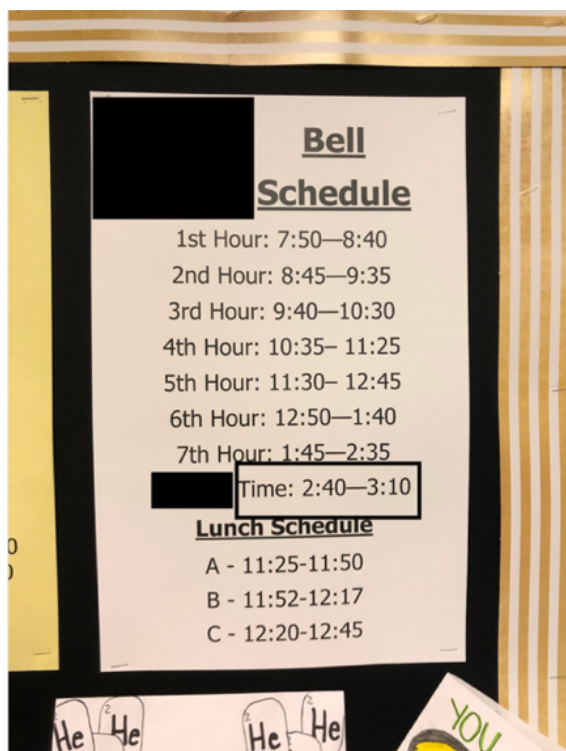


Figure 4. Boxed time showing academic extension.

The qualitative portion of my study focused on open-ended questioning from interviews with the female students who scored the higher or the lower scores on the survey tool. Female students who completed the quantitative survey tool were analyzed to calculate the two highest scores per grade level and the two lowest scores per grade level. On the survey, answers to questions 7 through 33 were analyzed via the Likert scale. Two resulting sets of data came from this analysis to answer research questions three and four. Higher scores of female students were compared with lower scores of female students. In the seventh grade lower scoring participant group, there were two participants that shared the same low mean. A participant was selected randomly from those two participants and interviewed. In total, I ended up with 12 students to interview on a one-on-one basis. The 12 female participant means can be found on Table 2. The interview questions were open-ended questions that revolved around the socio-cultural focus of engagement and interest in STEM from teachers, peers, parents/guardians and community, and extracurricular activities. Most students were interviewed during the academic extension time. However, three students had teacher aid time and therefore open time and were able to be interviewed during that time. It was important that participant time and interest in the research process was accounted for.

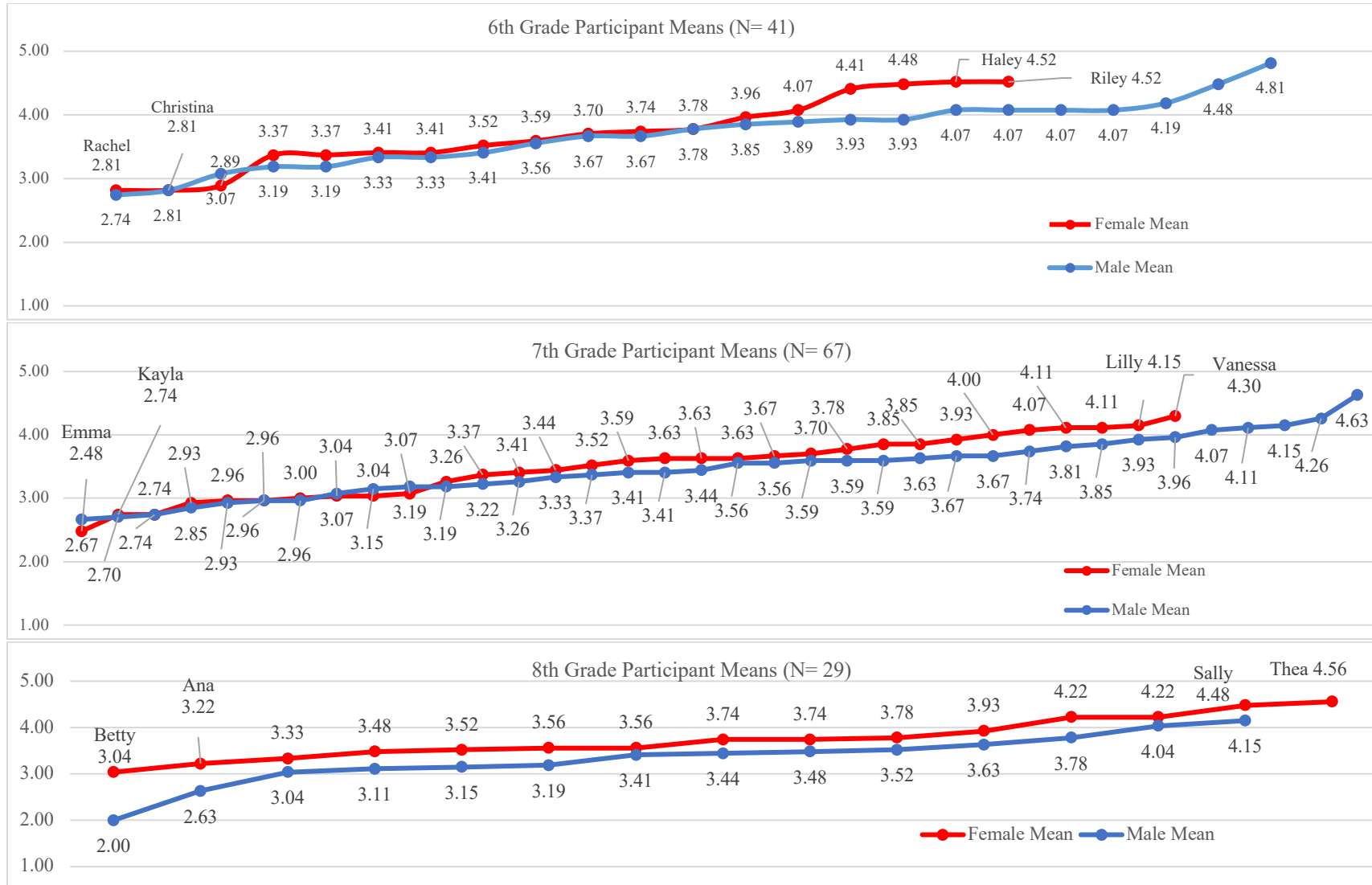


Figure 5. Participant Means

## **Materials**

In this mixed methods research, there were two specific tools utilized to gather data. As this method is explanatory sequential design, Creswell and Plano Clark (2018) explained that explanatory sequential design involves collecting the quantitative data and then using that data to set up the qualitative data (Creswell & Plano Clark, 2018). In this research, I used quantitative data to calculate the low and high scores in the survey of female students. The highest and the lowest female students were the students chosen for the interview for the qualitative portion of the study. There were two main tools that I applied in this research. The first tool utilized the survey for the quantitative portion. The second tool used the open-ended questions conducted through interviews.

### **Survey**

In this research, the quantitative data were investigated through a survey. The survey contained both a Likert scale selection and one open-ended question. The answers were used to compare both male and female responses to answer research question one and two of this study.

Parents/guardians who had consented for their student to participate in the survey listed their student's or students' name(s) on their consent form. I then manually connected email addresses and the academic extension teacher to give notification to students and to email and deliver the Qualtrics QR code and Qualtrics link to the survey (see Appendix H).

The survey contained 34 total questions. Qualtrics was the tool used to gather consent from parents/guardians, collect the assent from student participants, and share the

survey with participants. Since Qualtrics is web-based, students were able to work on the survey at home if they wished. Students had their entire academic extension time to complete the survey. On average, it took students 24 minutes to complete the survey. As academic enrichment is a time dedicated to relationship building, team focus, and homework completion time, students did not miss any academic time to complete the survey.

The survey originated from socio-emotional learning questioning from a Panorama Education Survey (2018). The questions were modified to connect to STEM learning and were assigned a Likert scale that would be applied to all questions. An example of this modification is shared. The original Panorama Education question was worded as “How often do you stay focused on the same goal for several months at a time?” with Likert responses of “Almost always, Frequently, Sometimes, Once in a while, Almost never” (Panorama Education, 2018). The question was modified to inquire “How often do you stay focused on a STEM idea, goal, or project for several months at a time?” with Likert responses “Always, Very often, Sometimes, Rarely, and Never”. In the survey, the first six questions from the total 34 questions, were utilized as a method to connect to participant interest (Archer et al., 2015). The last question was open-ended. This question provided valid results as it has been used successfully in previous research (Archer et al., 2015; Panorama Education, 2018),

The first six questions addressed demographic information of the participant in the survey. The following 27 questions utilized the Likert scale. The scale used a frequency scale between one and five, with one being “never,” two being “rarely,” three being “sometimes,” four being “very often,” and five being “always.” Questions seven

through 11 addressed student grit in STEM, questions 12 through 16 addressed student self-efficacy in STEM, and questions 17 through 24 addressed student social-awareness in STEM. In total, there were 18 questions that addressed socio-emotional competency and therefore, research question one. There were 9 questions from the Likert survey section, involving questions 25 through 33, that addressed socio-cultural influences and connected to question two of the research. Finally, there was one open-ended question, 34, that was used for the socio-cultural focus and connected to question two of the research (see Appendix D).

### **Open-Ended Question Interviews**

Following the analysis of data from the survey provided by students, I selected the highest scoring and lowest scoring female participants to interview. The purpose of selecting the extreme of high and low allowed for a comparison of differences. If I had used middle scores of the survey for participants, results may not have shown any correlation in particular questions. I ended up working with 12 participants regarding the open-ended question interviews. To collect the qualitative data, I interviewed the 12 participants with the open-ended interview questions. The questions related directly to research questions three and four of the research.

There was a total of seven open-ended questions (see Appendix F). Introduction questions were asked to create a comfortable environment between interviewer and interviewee. In an effort to connect with the participants, we often had side conversations regarding siblings or after-school activities, pending where the participant drove the conversation. The seven interview questions were broken down into socio-cultural influences (question one), student knowledge of STEM careers (question two), opinions



on STEM careers (question three), socio-cultural influences involving gender (question four), and socio-cultural influences involving peers (question five). Additionally, questions continued towards a deeper socio-cultural questioning through inquiries about parent/guardian influences and how extracurricular activities affect interest levels (questions six and seven).

Creswell and Plano Clark (2018) suggested that the qualitative portion of this research involve reviewing data which may include field notes, observations, and transcripts. During my investigation of this study, I utilized field notes, observations, and transcripts to help with the coding and data analysis of the qualitative portion of this study. In order to address the triangulation of data, the use of field notes (see Figure 4) and member checking of responses from interviews occurred in this research. Field notes helped to organize my thoughts whereas member checking helped to ensure that responses gathered were the intended responses. Participants in the open-ended questioning viewed their transcribed responses to update as necessary through email. Many participants corrected names and a few updated ideas (see Figure 5).

<u>Date</u>	<u>Notes</u>
4-18	V is an active participant. After seeing this student in the hall, I was surprised by the excited demeanor that was shown.
5-01	T was very reserved. Understand the acronym for STEM but did not elude to STEM careers of parents. <div style="border: 1px solid black; border-radius: 50%; padding: 10px; display: inline-block; margin-top: 10px;"> Wondering: When do parents engage in STEM  or  Is it up to educators? </div>

Figure 6. Example of field notes taken after interviews

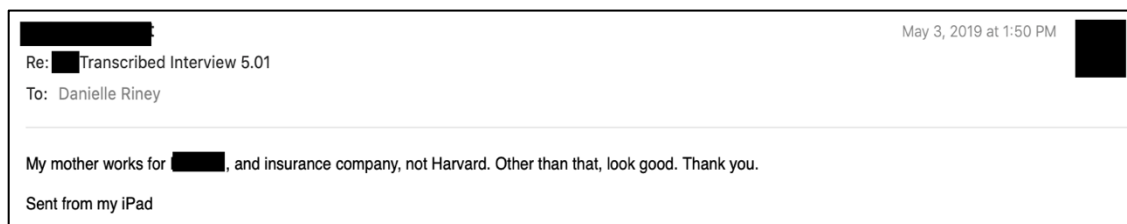


Figure 7. Example of member checking via email

## Procedures

For this mixed methods study, there were a variety of procedures that were necessary before beginning research. First, before collecting data, I obtained permission from the Institutional Review Board (IRB) at the University of Northern Colorado (see

Appendix A). After receiving IRB approval, I contacted the school district for consent (see Appendix B). The school district approved research in the school in spring. As soon as school district approval was given, I contacted parents of students digitally through email with the Qualtrics consent form to recruit for the research for approval (Appendix C). This was followed up by student assent for involvement in the research. Individual assent participation was requested digitally through a Qualtrics email link sent from school email and through a paper Qualtrics QR code (Appendix D).

Next, participant surveys and interviews were conducted on school grounds to maximize the comfortability of students while also being cognizant of participant time. Both surveys and interviews took place outside of academic time but during the school day, during academic enrichment time. Students completed the survey digitally through school-provided technology. Technology provided was either student iPad, laptop, or desktop computer. Through the use of digital technology, students were able to finish or take the survey at home if there were not available or present during academic extension time. For some students who were ill, they were able to check their email, click the link, and still take the survey. There were approximately 17% of the students who utilized the Qualtrics link from an email. The remaining 83% of students used their iPads to scan the Qualtrics QR Code to connect to the survey. After completing the survey, I analyzed data to compare the responses of males and females. I then investigated the female data to view the highest and lowest scores to set up interviews with participants. Interviews were semi-structured through open-ending questioning (Merriam, 2009) and inquired upon student responses regarding socio-cultural influences in STEM areas to answer research questions three and four.

Students were interviewed individually in my classroom. Students were allowed to sign up for an academic extension date and time that worked for their interview. After viewing available academic extension times, students may have also selected another time that they were free to participate, such as a teacher aide time or free hour before or after school. Three students chose to utilize their teacher aid time. There were also two students who used free time from cheerleading or dance practice, after school, to complete their interviews. Participant preference was given on the location of interviews. However, each participant felt that the classroom with no other students made for a comfortable location. At the time of the interview, students were given a list of the questions that were to be asked at the interview. I advised that these questions were a starting point and that during the conversation I may ask that we go in further detail. Interviews were conducted in 30 minutes. Students then were allowed to follow up with the transcriptions that were completed via emails sent to 12 female participants.

### **Data Analysis**

Jambu (1991) elucidated the definition of data analysis as “to synthesize the content of data in a database or a data file, by selecting specific data sets on which ‘data analysis methods’ can be applied” (p. 2). Data were collected through two different methods: survey and open-ended questioning, specific steps were followed to ensure a successful collection of data. Regarding quantitative data, Creswell and Plano Clark (2018) suggested that data should be analyzed through a process that revisits information to allow for recoding. They also recommended that information should be checked over visually to inspect for missing information (Creswell & Plano Clark, 2018). For the qualitative data, there were also essential steps to follow. Creswell and Plano Clark

(2018) proposed that the qualitative data should have thorough rechecks of transcriptions to allow for a review of accuracy and organization. I checked data once, had the member check their data, and then reviewed and checked the data a final third time. Additionally, initial thoughts from data coding were written down to be explored in greater detail and discussed in a code book (Creswell & Plano Clark, 2018). These processes helped to ensure that the data collection of this mixed methodology research was valid.

Creswell and Plano Clark (2018) further explained that mixed methods analysis required a two-step process. The first focus was to use a coding program. Both Qualtrics and SPSS were used in my research to give statistical representation to data. After this, data were summarized in tables and text. The interpretation of quantitative data took place so that the second focus of this research was able to continue. One open-ended question was coded and reviewed through content analysis. The seven open-ended qualitative questions were conducted through interviews. Again, Creswell and Plano Clark (2018) suggested that the qualitative data need to be coded, reviewed for themes, and interrelated between the various themes found. It was suggested that qualitative data be represented in visual models, text, or in various themes (Creswell & Plano Clark, 2018). Data were interpreted and summarized as the final step in the analysis.

### **Quantitative Analysis**

The first step of analysis with the quantitative survey was to explore the scales of measurement being utilized in this research. Through the use of Qualtrics, data were exported into a spreadsheet to be organized. This organization was very important as it helped to start creating the meaning for the survey that students had completed. In my next step, data were analyzed through exploratory multivariate analysis and was

conducted using a program called SPSS. I used factor analysis to find the factors of grit, self-efficacy, and social awareness in the socio-emotional survey section. I also used factor analysis to find the factors or socio-cultural influences and personal focus in STEM in the socio-cultural portion of the survey section. Factor analysis helped to classify data and find themes. This analysis also helped to confirm the three types of groupings involving the socio-emotional interests of students (Creswell & Plano Clark, 2018). The next analysis completed was descriptive analysis. By combing through the data, I was able to summarize and give meaning to patterns I found in the data. I looked at frequency, percentages, mean, median, mode, and range through calculations with SPSS. This analysis allowed for comparisons of means between genders. The final metric variable test utilized was the *t*-test. It was applied to compare response differences from the survey checking for significance, which then helped to address research questions one and two. As this was a two-tailed test, confidence was set at 95%, and therefore there would be a 2.5% possibility that the samples were skewed to the tail ends of the distribution (Blaikie, 2003). Therefore, alpha ( $\alpha$ ) was set to 0.05.

### **Qualitative Analysis**

There were two instances of qualitative analysis. The first existed in question two of the research to help analyze open-ended questions from the survey. Content analysis was useful in helping to examine the frequency and themes. From Bloomberg and Volpe (2016), “to conduct a content analysis on any text, the text is coded; that is broken down, into manageable categories on a variety of levels – word, word sense, phrase, sentence or them – and then examined using one of content analysis’ basic methods: conceptual analysis or relational analysis” (p. 199). Then descriptive analysis served as the tool to set

up the highest and lowest socio-emotional scores for females. Through this analysis of questions one and two, a review for the lowest and highest female scores in the survey was completed. This served as the tool to set-up interviews for questions three and four. Qualitative data were then be transcribed and organized to “reflect deeply on the contents and nuances” (Saldaña, 2016, p. 115).

For research questions three and four, there were multiple rounds of coding that took place. Initial lean coding (Creswell, 2012) took place to bring forward ideas and themes. Following this round, open coding was completed to look for any missed themes or ideas (Saldaña, 2016). The data were then organized via categories to find commonalities and themes. This was done between the high scores and the low scores of the 12 interviewed female participants. Clarifications and common themes were found between the two sets of groups. Those themes were then organized into smaller categories. Then, the data were analyzed to view the socio-cultural perspectives of middle school young women from the higher and lower scores of the socio-emotional influences and socio-cultural interests in STEM of female students. This helped to answer questions three and four.

Coded data were recorded electronically using a program called NVivo 12. Once data were recorded and organized, it was used to gain a complete understanding of how socio-cultural influences of higher and lower female participants affected young women and their STEM interests. By using the qualitative data following the quantitative data, new themes and ideas presented themselves. Creswell and Plano Clark (2018) explained that “A better approach therefore is to determine how the qualitative themes and codes

provide additional insight into and nuances about the quantitative database – an approach consistent with the explanatory sequence design intent” (p. 238).

### **Data Sources and Analysis by Research Question**

In Table 1, I organized my research questions and their data source and analysis. Research questions one and two (Q1 and Q2) are the quantitative questions for this explanatory sequential mixed methods research. Research questions three and four (Q3 and Q4) are the qualitative questions.



Table 1. Data sources and analysis by research questions

Research Question	Data Source	Analysis
Q1 Are there significant gender differences in the socio-emotional interests (grit, self-efficacy, and social-awareness) of middle school students found through the student survey questions?	• Likert Scale Survey	<ul style="list-style-type: none"> <li>• Factor Analysis including Cronbach's alpha, Kaiser-Meyer-Olkin measures, and Bartlett's Test of Sphericity</li> <li>• Descriptive Statistics</li> <li>• T-test of Significance</li> </ul>
Q2 Are there significant gender differences in the socio-cultural influences of middle school students found through the student survey questions?	<ul style="list-style-type: none"> <li>• Likert Scale Survey</li> <li>• An open-ended survey question</li> </ul>	<ul style="list-style-type: none"> <li>• Factor Analysis including Cronbach's alpha, Kaiser-Meyer-Olkin measures, and Bartlett's Test of Sphericity</li> <li>• Descriptive Statistics</li> <li>• T-test of Significance</li> <li>• Content Analysis Coding</li> </ul>
Q3 What socio-cultural perspectives do middle school young women with higher socio-emotional and socio-cultural STEM interests have?	• Open-ended interview questions	<ul style="list-style-type: none"> <li>• Lean Coding</li> <li>• Open Coding</li> </ul>
Q4 What socio-cultural perspectives do middle school young women with lower socio-emotional and socio-cultural interests have?	• Open-ended interview questions	<ul style="list-style-type: none"> <li>• Lean Coding</li> <li>• Open Coding</li> </ul>

### **Trustworthiness**

Creswell and Plano Clark (2018) mentioned validity threats in the research of explanatory sequential design of mixed methods. They suggested how important it is to first identify quantitative results and that researchers should “consider all possibilities for explanation of results” (p. 252). Through analyzing data, I was able to find the highest and lowest female participant scores from the survey. Qualitative data is suggested to be explained when approaching ideas that may be contradictory and the method to minimize issues with the idea of designing purposeful questioning in the qualitative section of research (Creswell & Plano Clark, 2018). Finally, an area that I viewed as most important is the connection of the quantitative data to the qualitative data (Creswell & Plano Clark, 2018). Participants were selected in my qualitative portion based upon their quantitative results, and this is seen as a solution to minimize threats (Creswell & Plano Clark, 2018). Additionally, in an effort to create the trustworthiness of the qualitative data, field notes and member checking helped triangulate information found. Through the use of member checking, participants viewed the transcribed data to update their personal responses. This allowed participants to double-check their meaning and understanding of questions and should ensure trustworthiness.

### **Summary**

A mixed methods design is what I feel best answered my four research questions. In mixed methods, I utilized an explanatory sequential design to answer the four questions of socio-emotional STEM engagement and socio-cultural interests and influences involving students at the middle school level. In an effort to answer these four

questions, I utilized my philosophical perspective of pragmatism and research provided by various mixed method researchers (Creswell, 2007; Creswell & Plano Clark, 2018; Johnson et al., 2007; Plano Clark & Ivankova, 2016; Tashakkori & Teddlie, 2016).

Aligned with the explanatory sequential design, there are two research strands: quantitative and then qualitative.

This study recruited 137 students from a middle school in the Midwest, seeking their opinions on socio-emotional competence and socio-cultural influences that may explain STEM interests or disinterests. Participants in the study answered survey questions. Those survey questions were analyzed between male and female responses. Data received was used to select participants in the qualitative interview section of the mixed methods research.

As an explanatory sequential study, this mixed methods research explored the socio-emotional competence of students in STEM areas, addressing questions one and two through the quantitative survey. In order for the quantitative data to help procure the qualitative data, further analysis of quantitative survey occurred showing the highest and lowest female scores seen through pooled means. Through this analysis, 12 students were selected for the qualitative portion of the open-ended questioning to answer socio-cultural questions from research questions three and four.

Data sources for this study stemmed from a Likert scale, initially. This was the tool utilized for the quantitative portion. As the survey was initially analyzed, students were selected for the open-ended interviews. For research questions, one and two, factor analysis, descriptive statistics, and *T*-tests were used to analyze survey data. Research question two used content analysis to explore the open-ended survey question, question

34. Research questions three and four involved open-ended interviews with 12 female participants. Responses were transcribed and checked, and member checked. The analysis consisted of two rounds of coding. Those rounds were lean coding with a codebook and open coding.

Trustworthiness was an essential factor used in mixed methodology for this research. In the quantitative portion of the study, I used a previously developed survey that I modified and aligned with appropriate STEM responses and Likert descriptions. Regarding the qualitative portion of the study, I used the trustworthiness factors for coding that various researchers had explained while conducting qualitative research (Creswell, 2007; Creswell & Plano Clark, 2018; Glesne, 1999; Merriam, 2009). These factors allowed for my research to support the validity of data, reliability of resources, and transferability of data.

## **CHAPTER IV**

### **RESULTS**

Explanatory sequential design was the method used to organize and streamline this research. In explanatory sequential design, there are two phases that I followed (Creswell & Plano Clark, 2018). The first phase was quantitative, and this allowed me to work with the Likert survey to explore the socio-emotional STEM interests and socio-cultural STEM influences of students. I was then able to compare the responses based on student gender. In order to complete the second phase of qualitative research, results of the Likert survey was used to gather participants for the qualitative portion. I calculated the overall mean of all female participants and then the two highest and two lowest scoring female middle school students in grades six, seven, and eight, were contacted for the second phase of qualitative research. The second phase was completed through interviews with the students selected from the results of the Likert survey. As Creswell and Plano Clark (2018) have explained, using the explanatory sequential design connects the quantitative results to the qualitative data collection allowing for data to be best connected in order to answer the research questions. This chapter shares both the data and significance of the Likert survey and also the responses of higher and lower scoring female participant interviews to answer the research questions of this study.

As there were four research questions, the most logical way to organize this chapter was by research question. I utilized data tables and figures to support the results

found for each question. Additionally, participant responses were used to help justify and organize findings and themes in the qualitative section of this study.

### **Research Question One**

The first research question of this study inquired, “Are there significant gender differences in the socio-emotional interests (grit, self-efficacy, and social-awareness) of middle school students found through the student survey questions?” In order to answer this question, I utilized the Likert survey results from the 137 recruited students. Factor analysis, descriptive analysis, and *t*-test analysis were used to answer research question one.

### **Factor Analysis**

Factor analysis has been described by Blaikie (2003) as “an interdependence technique in which a large set of variables is considered simultaneously in terms of their bivariate relationships” (p. 155). It is also described by Huck, Cormier, and Bounds (1974) as “a procedure that attempts to reduce the complexity of a multi-variable data set, so it becomes easier for people to use the data in applied settings or in the development/refinement of theory” (p. 479). Factor analysis was used in this research to explore the potential relationships between questions and to reduce factors as needed. It was also used to report the reliability of the survey used. In the Likert survey, questions seven through 24 focused on socio-emotional aspects.

As there were 73 male and 64 female responses ( $N = 137$ ), the utilization of the Kaiser-Meyer-Olkin measure and the use of Bartlett’s Test of Sphericity were satisfied. For these analyses, all questions of the socio-emotional survey were reviewed. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.86, above the commonly

recommended value of 0.60. Bartlett's test of sphericity was significant ( $\chi^2 (153) = 817.36, p < .05$ ). This significant value was  $2.66 \times 10^{-91}$ . In order to investigate the relationships found between the items in the Likert survey, a correlation matrix table was included (see Table 2). Likert survey questions do show correlations with other questions. The diagonals of the anti-image correlation matrix were all over the accepted value of 0.50 which would suggest that each item from the factor analysis was included (see Table 3). In addition, communalities were calculated, and all scored above 0.30 which would suggest that each question shared common variance with other questions (see Table 6).

Table 2. Correlations among socio-emotional questions

Question	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
Q7	1.00																	
Q8	.41**	1.00																
Q9	.30**	.24**	1.00															
Q10	.34**	.27**	.41**	1.00														
Q11	.42**	.35**	.19*	.20*	1.00													
Q12	.33**	.34**	.43**	.34**	0.13	1.00												
Q13	.27**	.33**	.41**	.26**	.19*	.44**	1.00											
Q14	.27**	.30**	.44**	.36**	0.16	.53**	.54**	1.00										
Q15	.25**	.25**	.37**	.27**	0.05	.53**	.47**	.46**	1.00									
Q16	.33**	.43**	.29**	.22*	.23**	.39**	.33**	.42**	.44**	1.00								
Q17	.32**	.43**	.27**	.24**	.34**	.20*	.19*	.22**	0.15	.25**	1.00							
Q18	.19*	.47**	.26**	.26**	.25**	0.16	0.11	0.08	0.09	.26**	.58**	1.00						
Q19	0.1	.27**	.28**	.45**	0.16	.26**	0.14	.20*	.19*	.21*	.32**	.46**	1.00					
Q20	.22**	.36**	.20*	.26**	.19*	0.16	.18*	0.16	.19*	.31**	.46**	.48**	.23**	1.00				
Q21	.22**	.30**	.22*	.21*	.17*	0.14	0.14	0.09	.19*	.18*	.33**	.34**	.40**	.43**	1.00			
Q22	.18*	.42**	.34**	.25**	.25**	.24**	0.15	0.14	0.15	.32**	.38**	.44**	.39**	.25**	.34**	1.00		
Q23	0.06	.27**	.25**	.25**	0.1	.27**	.24**	.25**	.20*	.23**	.46**	.37**	.38**	.32**	.23**	.32**	1.00	
Q24	0.11	.29**	.23**	0.16	0.15	.18*	.18*	.17*	0.14	0.12	.41**	.38**	.34**	.33**	.32**	.28**	.46**	1.00



Table 3. Anti-image socio-emotional correlation matrix

	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
<b>Q7</b>	0.81																	
<b>Q8</b>	-0.18	0.90																
<b>Q9</b>	-0.08	0.14	0.90															
<b>Q10</b>	-0.22	-0.02	-0.19	0.83														
<b>Q11</b>	-0.28	-0.10	-0.01	-0.02	0.85													
<b>Q12</b>	-0.15	-0.08	-0.11	-0.02	0.06	0.90												
<b>Q13</b>	-0.01	-0.15	-0.16	0.02	-0.08	-0.06	0.88											
<b>Q14</b>	0.05	-0.06	-0.16	-0.14	-0.01	-0.24	-0.28	0.85										
<b>Q15</b>	-0.02	0.03	-0.08	-0.04	0.12	-0.27	-0.22	-0.06	0.87									
<b>Q16</b>	-0.12	-0.16	0.00	0.11	-0.06	-0.03	0.02	-0.20	-0.24	0.87								
<b>Q17</b>	-0.17	-0.04	-0.01	0.06	-0.15	0.06	0.04	-0.12	0.00	0.08	0.88							
<b>Q18</b>	0.06	-0.23	-0.11	0.00	0.01	0.00	0.04	0.16	0.06	-0.06	-0.31	0.85						
<b>Q19</b>	0.13	0.06	0.04	-0.35	-0.04	-0.08	0.05	-0.04	-0.02	-0.04	0.04	-0.26	0.81					
<b>Q20</b>	0.03	-0.03	0.05	-0.15	0.01	0.03	-0.03	0.01	-0.02	-0.16	-0.14	-0.24	0.16	0.85				
<b>Q21</b>	-0.11	-0.06	-0.05	0.07	0.02	0.06	0.00	0.07	-0.09	0.05	-0.04	0.06	-0.27	-0.30	0.84			
<b>Q22</b>	0.09	-0.18	-0.20	-0.01	-0.07	-0.06	0.05	0.11	0.04	-0.15	-0.09	-0.10	-0.12	0.08	-0.13	0.89		
<b>Q23</b>	0.15	0.01	0.00	-0.06	0.07	-0.08	-0.09	-0.01	0.01	-0.06	-0.27	0.01	-0.13	-0.06	0.06	-0.06	0.87	
<b>Q24</b>	0.00	-0.06	-0.06	0.10	-0.02	0.00	-0.02	-0.04	-0.02	0.13	-0.09	-0.07	-0.10	-0.09	-0.11	0.00	-0.27	0.89

Through factor analysis, there were three factors found. Factor labels were assigned based upon the consistency of data. Factors were assigned as follows: grit, self-efficacy, and social-awareness. The method utilized for factor analysis was principle component analysis. There were three eigenvalues found above one. Together, the components calculated 51.53% of the variance, which is satisfactory. Commonly accepted values range between 40% to 60% (see Table 4). The scree plot agreed with the total variance components. There was little difference found between utilizing varimax or oblimin, and varimax was decided upon.

Table 4. Total variance of the socio-emotional section of the Likert survey

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
<b>Q7</b>	5.80	32.21	32.21	3.73	20.75	20.75
<b>Q8</b>	2.14	11.89	44.10	3.47	19.27	40.02
<b>Q9</b>	1.34	7.42	51.53	2.07	11.51	51.53
<b>Q10</b>	0.99	5.52	57.04			
<b>Q11</b>	0.94	5.23	62.27			
<b>Q12</b>	0.85	4.73	67.00			
<b>Q13</b>	0.73	4.08	71.07			
<b>Q14</b>	0.66	3.69	74.77			
<b>Q15</b>	0.61	3.38	78.15			
<b>Q16</b>	0.58	3.21	81.36			
<b>Q17</b>	0.52	2.89	84.25			
<b>Q18</b>	0.52	2.87	87.12			
<b>Q19</b>	0.48	2.67	89.79			
<b>Q20</b>	0.46	2.57	92.36			
<b>Q21</b>	0.42	2.32	94.68			
<b>Q22</b>	0.38	2.10	96.78			
<b>Q23</b>	0.30	1.65	98.43			
<b>Q24</b>	0.28	1.57	100.00			

In an effort to measure reliability, Cronbach's alpha was used to confirm that the Likert survey used was reliable. According to Ary, Jacobs, Sorensen, and Walker (2013), having a calculation above 0.70 denotes that a survey is good to very good reliability. Reliability measures the consistency of a tool (Ary et al., 2013). I used Cronbach's alpha to calculate the reliability of the survey and the factor loadings (see Table 5). The Cronbach's alpha values for the socio-emotional portion of the Likert survey was 0.87. With the factor analysis, questions identified for grit were 7, 8, and 11. The Cronbach's alpha for the grit component was 0.66. For self-efficacy, questions involved were 9, 10, 12, 13, 14, 15, and 16 and the calculated Cronbach's alpha was 0.82. For social-awareness, survey questions included were 17, 18, 19, 20, 21, 22, 23, and 24. The calculated Cronbach's alpha for social-awareness was 0.83. The factor loading analysis that was represented by these three components is found in Table 5 and varimax rotation provided the best factor structure.

Table 5. Cronbach's alpha for socio-emotional survey

<b>Factor Component</b>	<b>Cronbach's Alpha</b>	<b>N of Items</b>
Socio-emotional portion of Likert survey	0.87	18
Grit	0.66	3
Self-efficacy	0.82	7
Social-awareness	0.83	8

In Table 6, the components were shown in the factor analysis component matrix loadings. The first component, grit, had an eigenvalue of 1.34 with 7.42% of the variance. The second component, self-efficacy, had an eigenvalue of 2.14 and 11.89% of the variance. The third component, social-awareness, had an eigenvalue of 5.80 and contained 32.21% of the variance.

Table 6. Socio-emotional factor analysis component matrix loadings for Likert survey (N=137)

	Grit	Self-efficacy	Social-awareness	Communality
(7) How often do you stay focused on a STEM idea, goal, or project for several months at a time?	<b>0.73</b>	0.31		0.64
(8) If you fail to reach an important STEM idea, goal, or project, how likely are you to try again?	<b>0.56</b>	0.27	0.40	0.56
(9) When you are working on a STEM idea, goal, or project that matters a lot to you, how focused can you stay where there are lots of distractions?		<b>0.60</b>	0.28	0.45
(10) If you have a problem while working towards an important STEM idea, goal, or project, how well can you keep working?		<b>0.46</b>	0.32	0.34
(11) Some people pursue some of their goals for a long time, and others change their goals frequently. Over the next several years, how likely are you to continue to pursue one of your current STEM ideas, goals, or projects?	<b>0.74</b>			0.57
(12) How confident are you that you can complete all the work that is assigned in your STEM classes?		<b>0.76</b>		0.60
(13) When complicated ideas are presented in a STEM class, how confident are you that you can understand them?		<b>0.71</b>		0.54
(14) How confident are you that you can learn all the material presented in your STEM classes?		<b>0.79</b>		0.34
(15) How confident are you that you can do the hardest work that is assigned in your STEM classes?		<b>0.75</b>		0.57
(16) How confident are you that you will remember what you learned in your STEM classes, next year?	0.39	<b>0.51</b>		0.44
(17) During the past 30 days, how carefully did you listen to other people's points of view in STEM?	0.37		<b>0.66</b>	0.58
(18) During the past 30 days, how much did you care about other people's feelings in STEM?	0.28		<b>0.74</b>	0.63
(19) During the past 30 days, how well did you get along with students who are different from you (students who are less or more interested in STEM)?		0.24	<b>0.66</b>	0.50
(20) During the past 30 days, how often did you compliment others' accomplishments in STEM learning?	0.29		<b>0.57</b>	0.43
(21) During the past 30 days, how clearly were you able to describe your feelings regarding STEM learning?			<b>0.57</b>	0.37
(22) During the past 30 days, when others disagreed with you, how respectful were you of their views (particularly in STEM classes)?	0.25		<b>0.57</b>	0.41
(23) During the past 30 days, to what extent were you able to stand up for yourself without putting others down (particularly in STEM classes)?		0.28	<b>0.67</b>	0.55
(24) During the past 30 days, to what extent were you able to disagree with others without starting an argument (particularly in STEM classes)?			<b>0.67</b>	0.47
Eigenvalue	1.34	2.14	5.80	9.27
% of variance	7.42	11.89	32.21	51.53

Note: factor loadings above 0.45 are bolded and factor loadings < 0.2 are suppressed.

## Descriptive Analysis

I utilized descriptive analysis to describe the data found in the socio-emotional competence of middle school students in STEM. To analyze the data from the Likert scale, I coded responses using numbers. This analysis appeared as the following: 1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *very often*, and 5 = *always*.

From the factor analysis, there were three questions that were directly associated with grit from the Likert survey. Those questions were 7, 8, and 11 (see Table 7). There were seven questions related to self-efficacy, questions 9, 10, and 12 through 16 (see Table 8). Finally, there were eight questions related to social-awareness, questions 17 through 24 (see Table 9). Each of these questions asked participants to rate their socio-emotional grit, self-efficacy, or social-awareness in STEM as either *never*, *rarely*, *sometimes*, *very often*, or *always*.

In Table 10, the overall means of male participants and female participants are listed regarding the component of grit. The female participant mean (3.53) was higher than the male mean (3.32). The skewness and kurtosis were calculated and show the likelihood of a normal distribution of data.

Table 7. Grit questions showing overall mean.

Question Number	Survey Question	Male Mean	Male SD	Female Mean	Female SD
7	How often do you stay focused on a STEM idea, goal, or project for several months at a time?	3.29	0.91	3.33	0.80
8	If you fail to reach an important STEM idea, goal, or project, how likely are you to try again?	3.34	1.06	3.75	0.85
11	Some people pursue some of their goals for a long time, and others change their goals frequently. Over the next several years, how likely are you to continue to pursue one of your current STEM ideas, goals, or projects?	3.32	1.00	3.52	0.85
Overall Mean		3.32	0.99	3.53	0.84

Table 8. Self-efficacy questions showing overall mean.

Question Number	Survey Question	Male Mean	Male SD	Female Mean	Female SD
9	When you are working on a STEM idea, goal, or project that matters a lot to you, how focused can you stay where there are lots of distractions?	3.82	0.77	3.75	0.98
10	If you have a problem while working towards an important STEM idea, goal, or project, how well can you keep working?	3.60	0.86	3.78	0.83
12	How confident are you that you can complete all the work that is assigned in your STEM classes?	4.00	0.87	4.13	0.95
13	When complicated ideas are presented in a STEM class, how confident are you that you can understand them?	3.81	0.78	3.63	0.75
14	How confident are you that you can learn all the material presented in your STEM classes?	4.14	0.81	3.95	0.79
15	How confident are you that you can do the hardest work that is assigned in your STEM classes?	3.96	0.82	3.88	0.81
16	How confident are you that you will remember what you learned in your STEM classes, next year?	3.49	1.04	3.53	0.96
Overall Mean		3.83	0.85	3.81	0.86



Table 9. Social-awareness questions showing overall mean.

Question Number	Survey Question	Male Mean	Male SD	Female Mean	Female SD
17	During the past 30 days, how carefully did you listen to other people's points of view in STEM?	3.68	0.95	4.06	0.91
18	During the past 30 days, how much did you care about other people's feelings in STEM?	3.70	1.05	4.25	0.87
19	During the past 30 days, how well did you get along with students who are different from you (students who are less or more interested in STEM)?	4.01	0.77	4.39	0.68
20	During the past 30 days, how often did you compliment others' accomplishments in STEM learning?	3.33	0.99	3.50	0.96
21	During the past 30 days, how clearly were you able to describe your feelings regarding STEM learning?	3.32	1.07	3.61	0.92
22	During the past 30 days, when others disagreed with you, how respectful were you of their views (particularly in STEM classes)?	3.85	0.92	4.30	0.71
23	During the past 30 days, to what extent were you able to stand up for yourself without putting others down (particularly in STEM classes)?	3.90	0.85	4.14	0.75
24	During the past 30 days, to what extent were you able to disagree with others without starting an argument (particularly in STEM classes)?	3.78	1.00	4.06	0.89
Overall Mean		3.70	0.95	4.04	0.84

Table 10. Descriptive Statistics for grit comparing male and female participant responses.

	N	Mean	SD	Variance	Skewness	Kurtosis
Grit (Male)	73	3.32	0.99	0.98	-0.31	0.09
Grit (Female)	64	3.53	0.84	0.70	-0.32	-0.27

In Table 11, self-efficacy data is shown. The overall means of male participants and female participants were given. The male participant mean (3.83) was slightly higher than the female mean (3.81). The skewness and kurtosis were calculated and show the likelihood of a normal distribution of data.

Table 11. Descriptive Statistics for self-efficacy comparing male and female participant responses.

	N	Mean	SD	Variance	Skewness	Kurtosis
Self- efficacy (Male)	73	3.83	0.85	0.73	-0.46	0.12
Self- efficacy (Female)	64	3.81	0.86	0.75	-0.29	-0.48

Table 12 shows the social-awareness descriptive analysis data. The female participant mean (4.04) was higher than the male participant mean (3.70). The skewness and kurtosis were calculated and show the likelihood of a normal distribution of data.

Table 12. Descriptive Statistics for social-awareness comparing male and female participant responses.

	N	Mean	SD	Variance	Skewness	Kurtosis
Social-awareness (Male)	73	3.70	0.95	0.91	-0.41	-0.29
Social-awareness (Female)	64	4.04	0.84	0.71	-0.65	0.11

Female participants scored higher means than male participants regarding two factors. Those two factors were grit and social-awareness. Male participants scored slightly higher than female participants in the self-efficacy factor.

### **T-test Analysis**

To test the hypothesis for research question one and to investigate whether there was a statistically significant difference between the male and female participants of the socio-emotional survey, an independent samples *t*-test was completed. Each of the factor components for the socio-emotional survey were assessed separately. Means were compared in the *t*-test. Each of the questions had a calculated mean, *t*-value, and *p*-value (including degrees of freedom). An alpha level of 0.05 was used for all statistical tests. When significance was found, Cohen's *d* was calculated. Per Cohen (1988), significance values are shown through:  $d = 0.20$  (small significance),  $d = 0.50$  (medium significance), and when  $d =$  greater than 0.80 (large significance).

Male and female participants were compared to find the significance of their responses to the questions involving the factor of grit. Grit involved questions 7, 8, and

11. There was not a statistically significant difference found between male and female scores. Results indicated a non-significant effect for female participants ( $M = 3.53$ ,  $SD = 0.84$ ) and male participants ( $M = 3.32$ ,  $SD = 0.99$ ) regarding grit,  $t(135) = -1.77$ ,  $p = 0.15$ .

In order to test the hypothesis of a statistically significant difference in self-efficacy, a  $t$ -test was also calculated. Male and female participant means were analyzed to find the significance of their responses to the questions involving the factor of self-efficacy. Questions involved in the self-efficacy factor component were 9, 10, 12, 13, 14, 15, and 16. There was not a statistically significant difference found between male and female scores. Results indicated no significance when male participants ( $M = 3.83$ ,  $SD = 0.85$ ) and female participants ( $M = 3.81$ ,  $SD = 0.86$ ) selected their answers in self-efficacy,  $t(135) = 0.21$ ,  $p = 0.84$ .

There was a significant statistical difference found between male and female participants regarding social-awareness. Regarding social-awareness, there was a significance from female participants' answers ( $M = 4.04$ ,  $SD = 0.84$ ) and male participants' answers ( $M = 3.70$ ,  $SD = 0.95$ ),  $t(135) = -2.37$ ,  $p = 0.03$ . Cohen's  $d$  analysis was used to determine the magnitude or effect size of significance found. The Cohen's  $d$  was calculated as  $d = 0.38$ , the significance therefore showed a small effect ( $d = 0.20$  for small and  $d = 0.50$  for medium). As a secondary check for statistical measures, Hedges'  $g$  was also calculated. Hedge's  $g$  is often used when sample sizes differ (male = 73 and female = 64). It also used the same effect measures as Cohen's  $d$ . Hedge's  $g$  was calculated as the same measurement as Cohen's  $d$  at 0.38, showing small effect.

## **Research Question Two**

The second research question of this study inquired, “Are there significant gender differences in the socio-cultural influences of middle school students found through the student survey questions?” In order to answer this question, I applied the Likert survey results from the 137 participants recruited. The survey collected results for research question two through both scale items and one open-ended response. Research question two was analyzed by factor analysis, descriptive analysis, *t*-test, and the open-ended question was coded through content analysis.

### **Factor Analysis**

Factor analysis was used for research question two to explore relationships and factors found in the socio-cultural portion of the Likert survey. Factor analysis was also used to report the reliability of the survey used. For the second research question of this study, involving the socio-cultural survey questions, analysis was conducted on questions 25 through 33 of the study.

Research question two used the same sample of 137 participants as research question one. Therefore, the utilization of the Kaiser-Meyer-Olkin measure and the use of Bartlett’s Test of Sphericity were both satisfied when including 73 male and 64 female responses ( $N = 137$ ). The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.81, which was above the recommended value of 0.60. Bartlett’s test of sphericity was significant ( $\chi^2 (36) = 350.43, p < .05$ ). The significant value was  $3.45 \times 10^{-53}$ . In order to investigate the relationships found between the items in the Likert survey, a correlation matrix table was included (see Table 13). The diagonals of the anti-image correlation matrix were all over 0.50 which would suggest that each item from the factor analysis

was included (see Table 14). In addition, communalities were calculated, and all scored above 0.30 which would also suggest that each question shared common variance with other questions (see Table 17).

Table 13. Correlations among socio-cultural questions

	<b>Q25</b>	<b>Q26</b>	<b>Q27</b>	<b>Q28</b>	<b>Q29</b>	<b>Q30</b>	<b>Q31</b>	<b>Q32</b>	<b>Q33</b>
<b>Q25</b>	1.00								
<b>Q26</b>	.25**	1.00							
<b>Q27</b>	.25**	.26**	1.00						
<b>Q28</b>	.25**	.47**	.39**	1.00					
<b>Q29</b>	.16	.44**	.26**	.49**	1.00				
<b>Q30</b>	.14	.45**	.17	.41**	.42**	1.00			
<b>Q31</b>	.21*	.37**	.15	.34**	.29**	.38**	1.00		
<b>Q32</b>	.33**	.29**	.30**	.39**	.18*	.29**	.59**	1.00	
<b>Q33</b>	.49**	.32**	.42**	.32**	.20*	.16	.35**	.49**	1.00

Table 14. Anti-image socio-cultural correlation matrix.

	<b>Q25</b>	<b>Q26</b>	<b>Q27</b>	<b>Q28</b>	<b>Q29</b>	<b>Q30</b>	<b>Q31</b>	<b>Q32</b>	<b>Q33</b>
<b>Q25</b>	0.81								
<b>Q26</b>	-0.07	0.87							
<b>Q27</b>	-0.01	-0.03	0.81						
<b>Q28</b>	-0.04	-0.19	-0.22	0.85					
<b>Q29</b>	-0.02	-0.18	-0.09	-0.28	0.82				
<b>Q30</b>	0.00	-0.23	0.01	-0.14	-0.20	0.85			
<b>Q31</b>	0.04	-0.13	0.13	0.00	-0.11	-0.16	0.77		
<b>Q32</b>	-0.10	0.05	-0.10	-0.17	0.13	-0.07	-0.48	0.76	
<b>Q33</b>	-0.36	-0.12	-0.27	0.00	0.00	0.09	-0.09	-0.24	0.78

The socio-cultural questions were loaded into factor analysis. In an effort to conduct factor analysis, principle component analysis was completed. Factor labels were assigned based upon the consistency of data. In factor analysis, there were two eigenvalues found above one. Together, the components calculated 54.73% of the variance, which is satisfactory as commonly accepted values range between 40% to 60% (see Table 15). The scree plot also agreed with the total variance components. There was little difference found between utilizing varimax or oblimin, and varimax was decided upon.

Table 15. Total variance of the socio-cultural section of the Likert survey.

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
<b>Q25</b>	3.63	40.29	40.29	2.51	27.90	27.90
<b>Q26</b>	1.30	14.44	54.73	2.41	26.83	54.73
<b>Q27</b>	0.99	11.05	65.77			
<b>Q28</b>	0.75	8.36	74.13			
<b>Q29</b>	0.56	6.17	80.30			
<b>Q30</b>	0.54	6.00	86.30			
<b>Q31</b>	0.49	5.47	91.77			
<b>Q32</b>	0.41	4.54	96.31			
<b>Q33</b>	0.33	3.69	100.00			



Cronbach's alpha confirmed that the survey was reliable as the survey was calculated above 0.70 (Ary et al., 2013). The Cronbach's alpha values for the socio-cultural portion of the Likert survey was 0.81. Based on the factor analysis, I compared the Cronbach's alpha for the two factors. The calculated Cronbach's alpha for socio-cultural influences, which included questions 26, 28, 29, 30, and 31, was 0.77. The factor of personal focus in STEM included questions 25, 27, 31, 32, and 33, and had a Cronbach's alpha of 0.74. The Cronbach's alpha's are represented in Table 16.

In Table 17, the factor component matrix is listed. Question 31 was crossloaded in both factors (0.47 and 0.46) as it included both factor ideas of socio-cultural influences and the personal focus in STEM. Costello and Osborne (2005) suggested that the researcher should determine if an item should be removed from a factor component matrix and that it be decided upon the analysis of the other loadings by the researcher. In addition, according to Costello and Osborne (2005), explained that having fewer than three loadings may denote a weak factor. For this analysis, I decided to keep the crossloading due to researcher preference, maintaining a number of factors to ensure strong factor components, and also through the connectedness to both factors for question 31.

Table 16. Cronbach's alpha for socio-cultural survey

<b>Factor Component</b>	<b>Cronbach's Alpha</b>	<b>N of Items</b>
Socio-cultural portion of Likert survey	0.81	9
Socio-cultural influences	0.77	5
Personal focus in STEM	0.74	5

There were two components found in factor analysis. The first component, socio-cultural influences, had an eigenvalue of 3.63 with 40.29% of the variance. The second component, personal focus in STEM, had an eigenvalue of 1.30 and 14.44% of the variance (see Table 17).

Table 17. Socio-cultural factor analysis component matrix loadings for Likert survey (N=137)

	Socio-cultural influences	Personal focus in STEM	Communality
(25) A STEM focus in college can help you get many different types of job.		<b>0.72</b>	0.51
(26) When you are NOT in school, how often do you talk about STEM with other people?	<b>0.70</b>	0.26	0.56
(27) I know how to use scientific evidence to make an argument.	0.23	<b>0.54</b>	0.35
(28) When not in school, how often do you read books or magazines about STEM?	<b>0.68</b>	0.34	0.58
(29) When not in school, how often do you go to a science center, science museum, zoo, aquarium, or planetarium?	<b>0.77</b>		0.60
(30) How often are you involved in STEM related extra-curricular activities?	<b>0.77</b>		0.60
(31) My teachers have specifically encouraged me to continue with STEM areas in the future.	<u><b>0.47</b></u>	<u><b>0.46</b></u>	0.43
(32) My teachers have explained how STEM is useful for my future.	0.28	<b>0.71</b>	0.58
(33) It is useful to know about STEM in my daily life.		<b>0.84</b>	0.71
Eigenvalue	3.63	1.30	4.93
% of variance	40.29	14.44	54.73

Note: factor loadings above 0.45 are bolded. Underlined factor loadings show multiple loading on two factors. Factor loadings < 0.2 are suppressed.

## **Descriptive Analysis**

Descriptive analysis was used to describe the data found regarding gender differences in the socio-cultural learning of middle school students in STEM, found through the survey data. The Likert scale used responses of *never*, *rarely*, *sometimes*, *very often*, and *always*. I assigned numbers similar to quantify the data. This analysis appeared as the following: 1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *very often*, and 5 = *always*.

There were five questions (questions 26, 28, 29, 30, and 31) that aligned with the factor of socio-cultural influences (see Table 18). There were also five questions (questions 25, 27, 31, 32, and 33) that aligned with the factor of personal focus in STEM (see Table 19). There was one factor that was loaded on both factors, question 31. Each of the questions asked participants to rate their socio-cultural influences as *never*, *rarely*, *sometimes*, *very often*, or *always*.

Table 18. Socio-cultural influences questions showing overall mean.

Question Number	Survey Question	Male Mean	Male SD	Female Mean	Female SD
26	When you are NOT in school, how often do you talk about STEM with other people?	2.66	1.12	2.42	1.10
28	When not in school, how often do you read books or magazines about STEM?	2.51	1.09	2.48	1.18
29	When not in school, how often do you go to a science center, science museum, zoo, aquarium, or planetarium?	2.75	0.95	2.61	0.92
30	How often are you involved in STEM related extra-curricular activities?	2.71	1.03	2.47	1.10
31	My teachers have specifically encouraged me to continue with STEM areas in the future.	3.22	1.28	3.08	1.29
Overall Mean		2.77	1.10	2.61	1.12

Table 19. Personal focus in STEM questions showing overall mean.

Question Number	Survey Question	Male Mean	Male SD	Female Mean	Female SD
25	A STEM focus in college can help you get many different types of job.	4.26	0.78	4.31	0.77
27	I know how to use scientific evidence to make an argument.	3.64	1.03	3.70	1.03
31	My teachers have specifically encouraged me to continue with STEM areas in the future.	3.22	1.28	3.08	1.29
32	My teachers have explained how STEM is useful for my future.	3.25	1.38	3.42	1.23
33	It is useful to know about STEM in my daily life.	3.67	1.13	3.88	1.09
Overall Mean		3.61	1.12	3.68	1.08

In Table 20, the overall means of male participants and female participants were listed regarding the socio-cultural influences factor. The male participant mean (2.77) was higher than the female mean (2.61). The skewness and kurtosis were calculated and show the likelihood of a normal distribution of data.

Table 20. Descriptive Statistics for social-cultural influences comparing male and female participant responses.

	N	Mean	SD	Variance	Skewness	Kurtosis
Socio-cultural influences (Male)	73	2.77	1.10	1.22	0.27	-0.51
Socio-cultural influences (Female)	64	2.61	1.12	1.26	0.32	-0.32

Table 21 shows the factor of personal focus in STEM. This table shows the overall means of male participants and female participants. The male participant mean (3.61) was slightly lower than the female mean (3.68). The skewness and kurtosis show the probability of a normal distribution of data.

Table 21. Descriptive Statistics for personal focus in STEM comparing male and female participant responses.

	N	Mean	SD	Variance	Skewness	Kurtosis
Personal focus in STEM (Male)	73	3.61	1.12	1.30	-0.49	-0.50
Personal focus in STEM (Female)	64	3.68	1.08	1.21	-0.40	-0.71

### ***T*-test Analysis**

A *t*-test analysis was completed in order to test the hypothesis for research question two to investigate whether there was a statistically significant difference between the male and female participants in the socio-cultural influences portion of the Likert survey. Each of the factors for the socio-cultural survey were assessed separately. Means were compared in the *t*-test. Each of the questions had a calculated mean, *t*-value, and *p*-value (including degrees of freedom). An alpha level of 0.05 was used for all statistical tests.

For the factor of socio-cultural influences, an independent samples *t*-test was completed. For the factor of socio-cultural influences, means were calculated for questions 26, 28, 29, 30, and 31. Results indicated no significance between male participants ( $M = 2.77$ ,  $SD = 1.10$ ) and female participants ( $M = 2.61$ ,  $SD = 1.12$ ) regarding the factor of socio-cultural influences,  $t(135) = 0.93$ ,  $p = 0.38$ .

For the factor of personal focus in STEM, an independent samples *t*-test was completed. The personal focus in STEM involved questions 25, 27, 31, 32 and 33. Significance was not found for this factor. Results indicated no significant differences among male participants ( $M = 3.61$ ,  $SD = 1.12$ ) and female participants ( $M = 3.68$ ,  $SD = 1.08$ ) shared similar responses to personal focus in STEM,  $t(135) = -0.25$ ,  $p = 0.81$ .

### **Content Analysis of Open-Ended Questions**

There was one question from the Likert survey that was open-ended, inquiring upon the influences students have had regarding their STEM education. To answer



question two of this research question, I analyzed this qualitative data to compare responses between males and females.

To complete analysis on this open-ended survey question, I used content analysis. From Merriam (2009), content analysis is explained as the “process [that] involves the simultaneous coding of raw data and the construction of categories that capture relevant characteristics of the document’s content” (p. 205). For the process of coding these open-ended questions, I separated the responses into male and female responses. I read the male and female participant responses several times to try and become familiar with and understand the data. The next process of coding included open coding. I looked for duplicated themes and attempted to align and cluster those into codes. I did this many times to include all the results and to look for potential categories. I then reorganized to ensure that the coding made sense and did not miss any major themes. To calculate the frequency of the analysis, I then counted the codes from each of the categories established and calculated percentages. The emergent codes are discussed below.

**Encouragement in Science, Technology, Engineering, and Mathematics.** For survey question 34, male and female participants were asked who had influenced their STEM educations. After coding, percentages and frequencies were calculated (see Table 22). For influences in STEM, male participants were mostly influenced by their teachers (67.1%), then by parents/guardians (19.2%), followed by themselves (11.0%). For female participants’ influences in STEM, teachers contained the greatest influence of female participants (65.6%) followed by parents/guardians (31.3%).

Table 22. Frequencies of responses for question 34

<b>(Male) Who has Influenced your STEM education?</b>	<b><i>f</i></b>	<b>Percentage of 73</b>	<b>(Female) Who has Influenced your STEM education?</b>	<b><i>f</i></b>	<b>Percentage of 64</b>
Teachers	49	67.1%	Teachers	42	65.6%
Parents/Guardians	14	19.2%	Parents/Guardians	20	31.3%
Self	8	11.0%			

### **Research Question Three**

The third research question of this study inquired, “What socio-cultural perspectives do middle school young women with higher socio-emotional and socio-cultural STEM interests have?” In order to answer this research question, I interviewed six middle school female students. Two students represented sixth-grade (Haley and Riley), two participants represented seventh-grade (Lilly and Vanessa), and two interviewees represented eighth-grade (Sally and Thea). Female students were selected from the two highest means calculated at each grade level, from the Likert survey. These participants were contacted regarding an interview. Interviews were completed with the participants and transcribed. Participants then received an email containing the transcribed interview and were asked to make any necessary changes.

### **Interview and Qualitative Process**

There was a large amount of data produced from interviewing the higher scoring female participants. There were seven interview questions used to investigate the socio-cultural perspectives of interviewed participants (see Table 23). For each of those questions, qualitative coded themes were formed from lean coding and open coding with representative quotes from participants were shared.

Table 23. Interview Questions used to show socio-cultural perspectives

Question #	Question	Type of Question
1	Where have you heard about STEM careers? (i.e., influences from teachers, parents, peers)	Socio-cultural influences (influences)
2	Do you know of anyone in a STEM career? (i.e., parent, family member, neighbor) a. What do they do? b. Have they spoken with you about their career (the interesting and not so interesting aspects)?	Socio-cultural influences (influences)
3	What do you think about STEM careers? a. What do your peers think about STEM careers? b. What are girls your age taught to think about STEM careers? c. Who teaches that opinion (teachers, parents, peers)?	Socio-cultural influences (peer and gender)
4	Do you think there is gender bias regarding interest levels in STEM? Do you think there is a different gender perception?	Socio-cultural influences (gender)
5	To what extent does peer influence affect your interest levels of STEM?	Socio-cultural influences (peer)
6	To what extent do your parents/guardians influence your interest levels in STEM?	Socio-cultural influences (parents/guardians)
7	To what extent do extracurricular activities affect your interest levels in STEM?	Socio-cultural influences (extracurricular)

Creswell and Plano Clark (2018) describe coding as “the process of grouping evidence and labeling ideas so that they reflect increasingly broader perspectives” (p. 214). In order to conduct coding analysis, initial readings of the transcripts and hand-written memos were conducted to organize main themes presented through the interviews via a first lean coding method (Creswell, 2012). Creswell (2012) describes lean coding as the first time through a reading; a few codes were assigned so that they can be reduced and broadened at a later time. A codebook was created by hand to help organize ideas, initial themes, and reactions (Saldaña, 2016). The second round of coding then began with a round of open coding where coded themes were assigned to each question. This allowed for a review of data to ensure there were no missing themes.

**Influences regarding STEM careers.** In interview question one, the higher scoring female participants were asked where they had been influenced regarding STEM opportunities and careers. For the higher scoring female participants, a theme was assigned to question one. The theme for this question was: *educators influencing STEM careers*. There was also a sub-theme of *influences from family*.

***Educators influencing STEM careers.*** Each of the six participants were able to share experiences where they had heard about STEM opportunities. Initially, five out of the six higher scoring females (Sally, Thea, Vanessa, Riley, and Haley) noted that educators influenced their STEM learning regarding STEM careers. Additionally, Lilly and Riley responded about influences from her uncle and parents, respectively.

Sally, an eighth-grade student, emphasized how much she learned from a STEM conference that she was invited to by a teacher. The conference allowed her to review the “...different things that STEM reaches out to. Like it’s not just straight up physics or

calculus and stuff.” This helped Sally to realize the potential for success in a career in STEM. Sally added how the relationship she had with her seventh-grade science teacher had positively influenced her interest in STEM careers. Thea, an eighth-grade student, shared that she had also been influenced by school. She had also learned about STEM opportunities through coding programs and classes in school. In addition, she was influenced by “other events that [school name] has for female STEM career things, where they [professionals] try to encourage girls to do it [STEM].”

Vanessa, a seventh-grade student, remarked that she had received information on STEM “mainly” from by her seventh-grade science teacher. Haley, a sixth-grade student, shared that her teachers were the ones who shared information about STEM careers. To each of these young women, educators were introducing many of the students to the STEM fields.

*Influences from family.* Lilly, a seventh-grade student, shared how important her family was regarding influences in STEM. She explained how her uncle helped to interest her and her siblings through exposure to exciting science events with his profession as a scientist. Lilly shared that “He became a scientist and he would go, on the weekend, to these different STEM things” and would invite her and her siblings. She shared the positivity surrounding those experiences and how a STEM career is an area of interest for her. Riley, a sixth-grade student, also agreed that she had picked up information about STEM careers from school but also added that she was influenced by her parents.

**Personal connections to Science, Technology, Engineering, and Mathematics professions.** The higher scoring female participants were asked about a personal connection to STEM in interview question two. A theme was coded from the responses

of the higher scoring female participants. The theme that emerged from this question was: *greater connection to STEM professionals.*

***Greater connection to Science, Technology, Engineering, and Mathematics professionals.*** There were three higher scoring female participants who had spoken and connected with STEM professionals. Thea's father is a doctor. However, Thea explained that she personally is disinterested in continuing with a STEM career as a direct result of her father's profession as a family doctor. She shared this:

I feel like that kids whose parents are doctors don't really want to be doctors just because—not because it's so much work, but because he does a lot and he's on call every other weekend, and his schedule is the same every weekend. He has a day off on Wednesday, but then he works on weekends too...and I know not all STEM careers are like that and he does enjoy his job, but it is a lot of always on.

This quote suggests that as Thea understands the schedule of a doctor, but she realizes the time required may not be what she wants to do with her future.

Lilly and Riley also have family members who have explored STEM professions with them. Lilly's uncle has explained what he does and that has increased her interest in STEM, however, he had moved away and so she wishes he was closer to continue science career talks. For Riley, her father "works with math" and has helped when she has struggled with concepts and continues to guide her towards a STEM career.

**Impressions of Science, Technology, Engineering, and Mathematics careers.** Interview question three asked the higher scoring female participants what they thought of STEM careers, what they felt their friends believed about STEM, what they imagined

other females their age thought, and where they believe their impressions of STEM were taught. There were four themes that emerged from open coding. Those four themes found are: *details about STEM increase as grade levels increase*, *positive peer interest in STEM*, *strong self-efficacy in STEM*, and *Positive STEM influences from teachers and everyday culture*.

***Details about Science, Technology, Engineering, and Mathematics increase as grade levels increase.*** When the higher scoring female participants were asked what they thought of STEM careers, Vanessa, Lilly, Haley, and Riley all explained that acronym of STEM. They noted that it involved science, mathematics, engineering, or technology but did not go into further detail or specifics. Both eighth grade students, Sally and Thea, went into more detail. Sally specified, “I think mostly just like, sciences, biology, phycology [botany], NASA careers, [and] Physics.” Thea commented about technologically science based careers.

***Positive peer interest in Science, Technology, Engineering, and Mathematics.*** All higher scoring female participants commented regarding their best friends’ impressions of STEM careers. Sally and Vanessa explained that they each had friends who were interested in STEM but also had some friends who were interested in other areas not related to STEM. Overall, education regardless of focus was strong in Sally and Vanessa’s peer groups. Thea described that her best friends are interested in STEM, particularly medicine. Lilly noted the uncertainty of her friends, sharing that they would likely say, “What is that?” when asked about STEM whereas others were interested in it. Haley noted, “Most of my friends don’t pay attention, to be honest, so I think, probably,



they would just say what it means and not too much more.” Riley explained that her friends are interested in STEM, like she is.

***Strong self-efficacy in Science, Technology, Engineering, and Mathematics.***

When inquiring what the other girls were taught to think about STEM, the higher scoring female participants shared various opinions. Thea, Vanessa, and Riley shared how they believe that fellow females students are taught that STEM is something that will help them become successful in the future. Vanessa noted, “[Girls] are taught to maybe like it or enjoy it, because it may help them in the future.” Sally shared the same sentiment but also shared a concern about STEM:

I think they [girls] are taught to think about...how it opens up a world to a new area and I think that sometimes, I don’t know if this is true or not, there are less girls in STEM careers than guys.

Lilly and Haley shared some additional thoughts regarding STEM. Lilly explained:

Well, I know most people have these opinions, like stereotypes that would tell me they’re for smart people and people that think, like, they know what they’re doing and they’re just smart in general. But I kind of try to tell some of my friends that it’s just whatever you put your mind up to.

Haley shared, “That we [girls] can do it as well as boys. Because boys are usually more negative and say that girls can’t do that. But honestly girls can do anything if they work hard enough.” Through this quote, Haley explained the importance of STEM while also explaining the effort and persistence needed to allow any girl to do what they want to do.

***Positive Science, Technology, Engineering, and Mathematics influences from teachers and everyday culture.*** When inquiring where the higher scoring participants feel they were taught the opinion of STEM careers, Thea, Vanessa, and Riley shared they felt opinions on STEM were taught from teachers in school. Thea shared:

When we were younger [there was] the stereotype that science is for men.

But then when you get to [school name], there are a lot of programs that are like coding for girls, or the STEM field trip for girls, or the camps over the summer and stuff.

Haley explained that family influences most female students, sharing that her own grandmother had helped her because “My grandma because she has been through a lot of tough times. She is really wise. So, I know that she knows a lot of things.” Lilly and Sally explained that influences may come from sources in media. Sally elucidated, “More from the point of view and public eye and sometimes it’s actually fact.” For Lilly and Sally, the impressions on STEM grew from influences in everyday culture.

**Gender biases in Science, Technology, Engineering, and Mathematics and male peer perceptions on Science, Technology, Engineering, and Mathematics.** The higher scoring female participants were asked about if participants believed there was a gender bias regarding interest levels in STEM and about perceptions of STEM educations between genders. There were two themes that developed in interview question four:

*acknowledgment of gender bias and male peer attitudes differ from female peer attitudes.*

***Acknowledgment of gender bias.*** Of the six girls, five (Lilly, Riley, Sally, Hailey, and Thea) acknowledged gender biases in STEM. Lily noted that “I feel like boys have a little bit more of an advantage because some people think girls can’t be smart.”

Riley shared an opinion in STEM that “sometimes people might consider [STEM] more with males than females.” Sally noted a change in biases by sharing that “I think there was, but I think it’s mostly gone and for some people it’s still there because some people regard girls as not as strong as men and some people treat them as equals.” Regarding biases, Haley explained that “I think...no matter what your gender is, you can work up to your potential.” Thea responded regarding biases in school Thea explained,

I think that there is [gender bias] in the overall world but I do think it’s getting better. I don’t think there is as much at school, specifically or in our area, because there are all of these programs and they’re not marketed towards boys or girls. They’re marketed just in general.

Thea continued to explain a special event she had been invited to for STEM for girls only. She noted how her male classmates felt. Thea shared:

The guys always complain about “why does it say coding for girls? What if I want to code too?” Even though that’s the opposite of what this is going at, the guys might feel uninvited when [STEM programs] are trying to target girls.

*Male peer attitudes differ from female peer attitudes.* Sally explained that she felt the STEM education was similar between male and female peers. Sally compared her younger brother’s education and her education and noted no difference. However, Thea noted a difference in attention paid by male peers in science class. Thea added:

I mean, this is kind of separating them, but the boys don’t really pay attention in my class because we just don’t have a very good class. The guys never answer questions and they really don’t like our science class,

they don't pay attention...I feel like there's only two or three people in our class, and they're like [sic] all girls who do pay attention in science.

Vanessa noted that there was "a big difference. Like boys tend to be more [interested] towards sports." Haley explained that STEM classes were the same but that the attention given to teachers differed between male peers and female peers. She explained, "From my experience, a lot of boys goof off easily and don't pay attention. Where the girls can be more quiet, but I do know a few girls who can be more talkative." Lilly commented on the personalities of people in class. She explained that STEM classes are the same between male and female peers but that some students choose to participate in school because they are forced to do so by parents/guardians while others are excited and involved in classes without parent/guardian presence.

**Peer influences.** In interview question five, the higher scoring female participants were asked to what extent they were influenced by peers. The theme that appeared from coding the higher scoring female participants' responses was *close peers have the similar influences and interests*. This theme appeared multiple times for the higher scoring female participants.

*Close peers have the similar influences and interests.* For Haley, Riley, Thea, Sally, and Vanessa, they felt that their close friends were interested in the same areas of STEM which helped them to study and work well together. Sally shared an eye opening thought:

So, I think it all depends on who you hang out with. If you are hanging around kids who don't care much about school and education, then you're probably not going to care as much either. And then if you're with the

groups that are at a really high education level, really smart [sic], then you're going to push yourself to learn more and try to, in a sense, be better than them. To compete.

Sally explained how important competition can be in education, especially for success in STEM areas. She continued to describe the importance of good colleges and the necessity of scoring in the top of her class for high school, in order for success in STEM. Lilly noted that she had her own opinions on things and that her friends do not sway her interests much unless it involves something fun. Lilly explained that she would be more inclined to try something for herself to see if it was fun instead of being led by others.

**Parent/guardian influences.** The higher scoring female participants were asked about the influence their parents give regarding STEM in interview question six. After looking at the responses from the higher scoring participants, a theme was found. The theme was *parental encouragement for educational success*.

***Parental encouragement for educational success.*** For Riley, Vanessa, Lilly, and Thea, their parents expressed encouragement for educational success. However, these female participants noted that their parents did not specify that STEM is necessary area of study but emphasized the necessity of doing well in school. Haley shared that her parents want her to do things that she was interested in. Sally noted the importance in parent influences for student success. Sally shared:

Home influences mostly also. It all depends on how your parents raise you. In a sense if they are really pushing education, and if you find it interesting, they're going to help you go into that field rather than not caring and allow you to drop out of high school.

**Extracurricular interests and Science, Technology, Engineering, and Mathematics.** Female higher scoring participants were questioned to what extent they felt extracurricular activities influenced their interest levels in STEM, in interview question seven. Each of the higher scoring participants were involved in extracurricular activities. The theme that emerged from question seven for these higher scoring female participants was, *extracurricular activities lead to educational success*. For these higher scoring participants, they learned from experiences in activities that with hard work they formed skills to help them reach their potential goals.

*Extracurricular activities lead to educational success.* The resounding response from all participants was that being involved in extracurricular activities helped encourage success in education. Vanessa noted the importance of activities and the potential for them to help her in the future. Lilly explained how she learned specific skills like listening and problem solving which will help her in the future. Riley mentioned how extracurricular activities had helped her become optimistic while also helping her realize a positive potential for her success. Sally gained an interest in a potential career through extracurricular activities. She shared how softball enlightened her towards a career in sports medicine.

I think it [extracurricular activities] helps because I learned...[as] other people have gotten injured. Someone slid into the base wrong... she slid too late and she jammed her foot on the edge of the bag going into second and it messed up her leg...and broke her leg and was out of the season. So, it's actually kind of interesting to see how that happened, and how it can be prevented...It's interesting and makes you want to find out more.

Extracurricular activities helped the higher scoring female participants gain new skills and earn new experiences which helped guide these students towards interests in education.

The six higher scoring participants shared their responses in interviews. Responses from each of the seven interview questions were given. Themes were developed from the responses of the higher scoring participants. I show the themes and representative responses from each interview question in Table 24.

Table 24. Higher scoring female participant example responses and themes

Interview Question	Theme	Description of Theme	Example Responses from Participants
1. Influences regarding STEM careers	Educators influencing STEM careers	Educators have built relationships that engage students towards STEM	“Mainly [teacher's name] has explained STEM careers to me. [Teacher's name] shared opportunities in life science and a couple other areas.” (Haley)
	(Sub Theme) Influences from family	Family engages through experiences in STEM	“He [Lilly's uncle] became a scientist and he would go, on the weekend, to these different STEM things.” (Lilly)
2. Personal connections to STEM professions	Greater connection to STEM professionals	Having a greater connection to a STEM professional guides participants in regard to STEM careers.	“My dad's in a STEM career where he works with math. He helps me focus on tough math and guides me towards making better choices.” (Riley)
3. Impressions of STEM careers	Details about STEM increase as grade levels increase	STEM is more than the acronym. There are a variety of careers that fit into the categories of STEM.	“I think mostly just like, sciences, biology, phycology [botany], NASA careers, [and] Physics.” (Sally)
	Positive peer interest in STEM	Peers exhibit positive viewpoints in STEM.	“I would say that some of them would say they like it. And others would say that’s not really their thing. But we all try hard in school.” (Vanessa)
	Strong self-efficacy in STEM	There is success in for girls in STEM, but it may take effort and persistence.	“[Girls] are taught to maybe like it or enjoy it, because it may help them in the future.” (Vanessa) “That we [girls] can do it as well as boys. Because boys are usually more negative and say that girls can’t do that. But honestly girls can do anything if they work hard enough.” (Haley)
	Positive STEM influences from teachers and everyday culture	High scoring female participants understanding of STEM.	“When we were younger [there was] the stereotype that science is for men. But then when you get to [school name], there are a lot of programs that are like coding for girls, or the STEM field trip for girls, or the camps over the summer and stuff.” (Thea)



Table 25. Continued

4. Gender biases in STEM and male peer perceptions on STEM	Acknowledgment of gender bias	Gender biases are changing in STEM.	“I think there was, but I think it’s mostly gone and for some people it’s still there because some people regard girls as not as strong as men and some people treat them as equals.” (Sally)
	Male peer attitudes differ from female peer attitudes	Attitudes from male peers differ from female peers regarding learning focuses.	“The guys never answer questions and they really don't like our science class, they don't pay attention...I feel like there's only two or three people in our class, and they're like [sic] all girls who do pay attention in science.” (Sally)
5. Peer influences	Close peers have similar influences and interests	Surrounding oneself with peers that like the same things and are influenced by education help students be successful.	“So, I think it all depends on who you hang out with. If you are hanging around kids who don’t care much about school and education, then you’re probably not going to care as much either. And then if you’re with the groups that are at a really high education level, really smart [sic], then you’re going to push yourself to learn more and try to, in a sense, be better than them. To compete.” (Sally)
6. Parent/guardian influences	Parental encouragement for educational success	Parents that encourage their students and show the importance of education, are going to help their students be successful.	“I know one year, we did a ton of science camps [and] bible study camps because my dad says, "...If you just stay in the house and do nothing, you're not learning anything." So yes, my dad is a very big person on school and education.” (Lilly)
7. Extracurricular interests and STEM	Extracurricular activities lead to educational success	Being involved in extracurricular activities helped encourage success in education.	<p>“I kind of apply what I learn in theater to real life by listening, it's a skill that's really important to me, just listening.” (Lilly)</p> <p>“By doing my things [extracurricular activities] it helps me work harder. I try harder on everything.” (Haley)</p> <p>“...It’s interesting and makes you want to find out more.” (Sally)</p>

### **Research Question Four**

The fourth research question of this study queried, “What socio-cultural perspectives do middle school young women with lower socio-emotional and socio-cultural interests have?” To answer this research question, I used open-ended interview questions from the lower scoring female students. These students were selected from pooled means of the lower scoring females from the Likert survey. Pooled means were used to find the two lowest scoring female results from each grade level. There were a total of six female participants who were interviewed to answer research question four. Two of the interviewees were sixth-grade students (Rachel and Christina), two were seventh-grade students (Emma and Kayla), and two were eighth-grade students (Betty and Ana). Interviewees were conducted and then transcribed. Participants received an email with their transcribed interviews and were asked to make any necessary changes.

### **Interview and Qualitative Process**

When interviewing the lower scoring female participants, seven interview questions were used to report findings as those questions were connected to socio-cultural perspectives. For the seven interview questions, qualitative coding practices and representative quotes from participants are included. The seven interview questions used are found in Table 19.

There were two rounds of coding completed to find the themes developed from the lower scoring female participants. The first round focused on the lean coding method where handwritten codes were assigned to questions so they could be reviewed later (Creswell, 2012). The second round of coding involved open coding to assign developed themes to each question.

**Influences regarding Science, Technology, Engineering, and Mathematics careers.** Regarding interview question one, the six lower scoring female participants shared their influences on STEM opportunities for careers. The theme of *educators influence of STEM careers* became present through the interviews with the lower scoring female participants.

***Educators influencing of Science, Technology, Engineering, and Mathematics careers.*** Many of the lower scoring participants noted influences from educators. Ana, an eighth-grade student, explained that teachers in math and science had previously mentioned STEM opportunities in class. Betty, an eighth-grade student, noted that she was expecting teachers to explain more information and that she predicted to hear more “when we visit high schools and stuff like that.” Kayla, a seventh-grade student, explained that teachers had influenced her regarding STEM, she explained, “I know there are different types of scientists. There’s like, [teacher name] talked about, scientists in a lab, lab scientists, earth scientists. There’s lots of different kinds.”

For Christina, a sixth-grade student, first-grade was when she was first introduced to STEM. She shared “We had this whole lab. It was a STEM lab. My teacher was all about doing fun STEM activities.” When inquired if she had any recent influences, she explained that she had not. Rachel, a sixth-grade student, described her first STEM classroom experiences. Rachel explained:

So, what I’ve heard about it from was in 5<sup>th</sup> grade...when my teachers were starting to talk about STEM and showing us some STEM things...I know when I was sitting in the room and everyone was learning about STEM and all the stuff, I know a bunch of people said that it was kind of

confusing and it was kind of, like, hard. And another side [of students] thought it [STEM] was cool and they liked it but at the same time, it was like [sic], okay. I don't want to do it, but I like it.

For these six lower scoring female participants, influences regarding STEM careers were mentioned as being connected or shared in school settings by educators.

However, Emma, a seventh-grade student, did not share an influence from school. Emma explained that STEM influences were not present in her education. When inquiring more deeply, she explained that STEM discussions between educators and herself were "Not really there."

**Personal connections to Science, Technology, Engineering, and Mathematics professions.** Interview question two inquired if the lower scoring female participants knew of a person in a STEM career. The question also asked participants if they could describe what that person with a STEM career did in their career and if they had a conversation with that individual about their career.

***Less connection to individuals in Science, Technology, Engineering, and Mathematics.*** For interview question two, five out of the six participants expressed that they did not have a strong connection to a person in STEM. Ana, Rachel, and Christina all shared that they knew of either a neighbor, parent of a peer, or family friend who have a career in STEM. However, they did not go into detail with that person about their career. For instance, Ana said, "I think my neighbor is an engineer, but I don't know deeply what he does." Christina explained, "I think I have a [family] friend who is an engineer." However, both Ana and Christina had not had conversations with the

respective engineers they knew regarding their careers. Emma and Kayla shared that they were unaware of what most adults around them did for their careers.

Betty, however, was the only participant from the lower scoring female participants who shared a connection to a STEM professional. Betty explained that her father is an engineer who works five days a week. Betty described how she and her father have not gone into great detail regarding his job, but she knew what he did, for the most part, in his career.

### **Impressions of Science, Technology, Engineering, and Mathematics careers.**

Interview question three asked each of the six lower scoring female participants about what they thought STEM careers were. In addition, the question asked what the lower scoring female participants believed their friends felt about STEM. The question also inquired what participants felt other females their age thought about STEM, and where ideas of STEM careers were taught. There were four themes that emerged from this question. Those themes were: *simplified ideas of STEM*, *less peer interest in STEM*, *disinterest and lesser self-efficacy for STEM*, and *mixed STEM influences from teachers and everyday culture*.

***Simplified ideas of Science, Technology, Engineering, and Mathematics.*** When the lower scoring female participants were asked about STEM careers, Christina, Rachel, Kayla, Betty, and Ana all responded with the acronym for STEM. However, Emma shared that STEM is "...a really hard job to get into and [has] a really prestigious title." This quote suggested that Emma knew the benefits of STEM and may have also understood the hard work and grit necessary to be successful in STEM.

*Less peer interest in Science, Technology, Engineering, and Mathematics.* Next, the lower scoring female participants were asked what their friends would think about STEM careers. All six participants noted how their friends would not be interested or may not know what STEM was. For instance, Emma shared, “I don’t think that really interests them [my friends] either. They’ll say, ‘yes that’s nice’ and then talk about their careers that they would do.” Each of the lower scoring participants shared similar responses about how their friends viewed STEM careers.

*Disinterest and lesser self-efficacy for Science, Technology, Engineering, and Mathematics.* The next question asked what the lower scoring female participants believed girls their age were taught to think about STEM careers. The six participants shared viewpoints of what girls thought about STEM below. Christina, Kayla, and Rachel shared the acronym for STEM whereas Ana, Emma, and Betty shared viewpoints. Ana explained that girls her age are taught that STEM is described as “...usually engineers are men, like [sic], that’s what people think.” Emma described STEM careers, noting,

They're [girls her age] taught to think it's a prestigious title, I guess, but they never really want to do it. Like [sic], their parents are always encouraging them to do it, but I don't think they actually want to.

When inquiring further as why Emma did not think girls her age were interested in STEM, she explained, “Because that's not what a lot of girls are interested in these days. I mean, some girls are, but a lot aren't.” Betty shared the positive view of STEM from the perspective of girls her age, sharing that it is a “good path to use, for jobs. A lot of jobs have STEM careers.”

***Mixed Science, Technology, Engineering, and Mathematics influences from teachers and individuals.*** The six participants discussed their opinions of where STEM career impressions were developed. For Anna and Betty, opinions of STEM careers formed from impressionable teachers in STEM areas. Betty shared that STEM careers were brought up by “Probably teachers, mostly.” Ana explained how some students are likely influenced by “a male teacher or something like that” as she explained the profession of engineering. Christina, Kayla, and Rachel shared that their early elementary years helped introduce STEM. Emma explained that she had not really formed any impressions of STEM from teachers or anyone around her.

***Gender biases in Science, Technology, Engineering, and Mathematics and male peer perceptions on Science, Technology, Engineering, and Mathematics.*** In interview question four, lower scoring participants were interviewed regarding their thoughts on gender biases in STEM and how middle school male peers perceived their STEM educations. The themes that emerged were *Mixed opinions on gender bias in STEM* and *no difference in STEM perceptions or attitudes of male peers*.

***Mixed opinions on gender bias in Science, Technology, Engineering, and Mathematics.*** The six participants varied on their opinions of gender bias. Two of the lower scoring participants (Rachel and Emma) did not see gender bias. Rachel shared, “there are a lot of people like girls and boys that do STEM.” Emma also explained “I think people like to say the careers are meant for boys, but I don’t think that’s really true. I think both girls and boys can both go into STEM careers.” The remaining four participants (Ana, Christina, Emma, and Kayla) noted biases that exist in STEM. Ana shared how she felt there was a bias regarding the employment of one gender over the

other and that there “probably is a bias towards women in STEM”. Emma shared that STEM is “not what a lot of girls are interested in these days. I mean, some girls are, but a lot aren’t.” Kayla explained that gender bias in STEM may be an example of stereotyping through the following quote:

I think it’s more, stereotypical, they’re [girls are] just not as interested in it [STEM]. Girls have a different, not necessarily mindset, it’s just harder for them...then like there are some that really enjoy STEM. I guess it depends on the person.

Kayla continued to explain the gender bias:

When I was little, I thought that STEM, like engineers [engineering], was for boys or whatever [sic], or like science was for boys, or whatever. But I think that you could, if you wanted to, be like [sic], work in STEM, you could and anyone could work in STEM, like not just guys...I definitely think it is an option for girls, but I don’t know if they are as interested in it as boys are.

Christina also noted the differences in STEM explaining the bias as “boys do all the hand-work [handiwork] and projects and the girls do all the ‘I don’t want to get my hands dirty’ work.” Christina explained that “lot of boys do it [STEM] because they like [to] do all the hand-work [handiwork].” Christina explained that impressions came from the individual and the things that they like to do.

***No difference in Science, Technology, Engineering, and Mathematics perceptions or attitudes of male peers.*** The lower scoring female participants overwhelmingly, with five out of six participants (Betty, Christina, Emma, Kayla, and



Rachel), felt male peers had no difference in the perceptions they had in STEM. Christina explained that, “I think everyone is about the same. They like to get good grades and not fail any of their classes.” Additionally, Betty noted how “I think that the teachers talk to all of them [us], so they [male and female peers] have the same opinion.” However, Ana explained how she felt there was a difference between male and female peers regarding STEM. Ana explained:

I think a lot more boys want careers in science, or they are more open about their wanting to be in science and math, than girls. Maybe because, just sometimes, if people think engineers, they think more men than women. So, boys think that it’s easier for them to, maybe, become an engineer.

For the lower scoring females, Ana was in the minority regarding her opinion.

Resounding opinions were that all peers thought the same regarding STEM.

**Peer influences.** The lower scoring female participants explained the extent that they were influenced by peers from interview question five. The theme that developed through interviews with lower scoring participants was *relationships with peers decide interest in STEM activities*.

***Relationships with peers decide interest in Science, Technology, Engineering, and Mathematics activities.*** For the lower scoring female participants, peers seemed to influence their interests. Emma, Rachel, Christina, and Kayla explained how important their peers’ influences in STEM was through noting that they would not outwardly seek STEM programing unless their friends also did so. Kayla explained, “if someone would say, I don’t like that, I would be like ‘me too’. If they said I love it, I might look again at

it.” Ana explained that her close peers can influence her interests. She noted, “Obviously, I would rather do something with my friends, like as an activity or lab, than alone. If my friends aren’t as interested in it, and I don’t really want to do it, I might not do it.” Betty shared a similar response, “If my friends want to do something [high school program], I might look into it too to see if it something I would also be interested in doing.” For the lower scoring female participants, peer relationships can be influential in deciding interest in STEM activities. For these participants, peers decide the interest level of activities and that may decide how likely a person is to participate.

**Parent/guardian influences.** In interview question six, lower scoring female participants were asked about the magnitude to which they were prompted by their parents and guardians to be interested in STEM. There was one theme that developed for the lower scoring female participants. That theme was *parental guidance regardless of interest in STEM, for educational success*.

***Parental guidance regardless of interest in Science, Technology, Engineering, and Mathematics, for educational success.*** Kayla, Emma, and Christina all noted that they felt their parents want the best for them. Emma shared that she felt her parents were happy with whatever choices she made in her schooling, even if it did not involve STEM. Ana shared a similar idea although she felt her parents may push her towards more STEM opportunities. She shared, “My parents, they want me to do more educational activities, so they try to push me to do things that are good, and I would probably listen to them.” Betty explained that parents have a big influence on their children. Betty remarked that:

Maybe because girls don't think it's [STEM] something they should be doing but guys do, maybe, because of their parents. Parents are a pretty big influence. Because I want to make them proud on what I do, obviously, but I also don't want to do something just because they tell me to do it.

Betty wants to be successful while also being capable of studying her own interests.

Rachel feels that her parents want her to be successful and it is their influence that will drive her success. Rachel explained how helpful her father is to her in her STEM interests:

So, my mom, I don't think she's much involved in STEM but my dad, he's involved in science and math...[My dad has] shown my siblings and my mom how to fix stuff and how to make things work...He helps me a lot with it [STEM] and I think if I were to, like [sic], ask him about what he thinks about STEM and [its] influence on me, I think he would really push me to do it because he likes it.

**Extracurricular interests and Science, Technology, Engineering, and Mathematics.** The lower scoring female participants were asked in interview question seven, how extracurricular activities have affected their interests in STEM. The lower scoring participants shared responses that developed the theme for interview question seven. The theme for question seven was, *no connection between extracurricular interests and STEM*.

*No connection between extracurricular interests and Science, Technology, Engineering, and Mathematics.* Christina, Rachel, Emma, and Kayla did not see how extracurricular activities changed or influenced their interests in STEM. Kayla explained her personal thoughts regarding extracurricular activities noting that, “I don’t really think there is [an affect] for me. But there’s, like, different math and science extracurricular. They don’t affect me, but they might [for] other kids.”

For Betty and Ana, extracurricular activities have helped influence their educations but not necessarily towards STEM areas. As Betty’s extracurricular activities involving dancing, she has learned that she wants to continue to be active in her studies. She explained, “I dance, so it [dancing] makes me want to do more active things with my future career.” Betty explained how she would likely pursue a dance focus and not a STEM area due to her active nature. Ana feels that she has learned to collaborate well with others through her extracurricular activities, however she does not see a connection with her extracurricular activities, collaboration, and STEM. Female lower scoring participants did not explain how extracurriculars may connect their interest in STEM.

The six lower scoring female participants shared their responses from the open-ended interviews. Each of the lower scoring participants responded to the seven interview questions. As responses were recorded and transcribed, themes were developed from the responses of the lower scoring participants. A description of each theme is included. I have shown the themes and representative responses from each interview question in Table 25.

Table 26. Lower scoring female participant example responses and themes

Interview Question	Theme	Description of Theme	Representative Responses from Participants
1. Influences regarding STEM careers	Educators influencing STEM careers	STEM careers were mentioned as being connected or shared in school settings by educators.	"I know there are different types of scientists. There's like, [teacher name] talked about, scientists in a lab, lab scientists, earth scientists. There's lots of different kinds." (Kayla)
2. Personal connections to STEM professions	Less connection to individuals in STEM	Less role models to discuss STEM careers.	"I think my neighbor is an engineer, but I don't know deeply what he does." (Ana)
3. Impressions of STEM careers	Simplified ideas of STEM	Simple explanations with difficult and prestigious positions.	"...a really hard job to get into and [has] a really prestigious title." (Emma)
	Less peer interest in STEM	Peers expressed less interest in STEM.	"I don't think that [STEM] really interests them [my friends] either. They'll say, 'yes that's nice' and then talk about their careers that they would do." (Emma)
	Disinterest and lesser self-efficacy for STEM	STEM may not be an interest for everyone.	They're [girls her age] taught to think it's a prestigious title, I guess, but they never really want to do it. Like [sic], their parents are always encouraging them to do it, but I don't think they actually want to. (Emma) "good path to use, for jobs. A lot of jobs have STEM careers." (Betty)
	Mixed STEM influences from teachers and individuals	Teachers share STEM opinions which may interest male peers. Opinions are also driven by stereotypes involving peers.	"Probably teachers, mostly." (Betty) students are likely influenced by "a male teacher or something like that" as she explained the profession of engineering (Ana)
4. Gender biases in STEM and male peer perceptions on STEM	Mixed opinions on gender bias in STEM	Differing opinions on biases in STEM noting there is no bias but then showing biases.	"boys do all the handwork and projects and the girls do all the 'I don't want to get my hands dirty' work." (Christina) "When I was little, I thought that STEM, like engineers [engineering], was for boys or whatever [sic], or like science was for boys, or whatever. But I think that you could, if you wanted to, be like [sic], work in STEM, you could and anyone could work in STEM, like not just guys...I definitely think it is an option for girls, but I don't know if they are as interested in it as boys are." (Kayla) "I think that the teachers talk to all of them [us], so they [male and female peers] have the same opinion." (Betty)
	No difference in STEM perceptions or attitudes of male peers	Both male and female peers are taught the same material and so there is no difference in STEM.	"I think everyone is about the same. They like to get good grades and not fail any of their classes." (Christina)

Table 25. Continued

5. Peer influences	Relationships with peers decide interest in STEM activities	Peers decide the interest level of activities and that decides how likely a person is to participate.	“if someone would say, I don’t like that, I would be like ‘me too’. If they said I love it, I might look again at it.” (Kayla)
6. Parent/guardian influences	Parental guidance regardless of interest in STEM, for educational success	Parents’ guide their students towards educational success, but it may not be what students are interested in.	“...Parents are a pretty big influence because I want to make them proud on what I do obviously, but I also don’t want to do something just because they tell me to do it.” (Betty) “...He [Rachel's Dad] helps me a lot with it [STEM] and I think if I were to, like [sic], ask him about what he thinks about STEM and [its] influence on me, I think he would really push me to do it because he likes it.” (Rachel)
7. Extracurricular interests and STEM	No connection between extracurricular interests and STEM	Interest in extracurricular activities did not connect to interests in STEM	“I don’t really think there is [an affect] for me. But there’s, like, different math and science extracurricular. They don’t affect me, but they might [for] other kids.” (Kayla)

### Summary

This chapter communicated the findings that were found to answer the research questions of this study. The first two research questions of this study were quantitative inquiring upon the statistical significance. Research questions three and four were qualitative, answering the open-ended questions from interviews.

To answer research question one, the socio-emotional questions from the Likert survey was used. To demonstrate trustworthiness of the quantitative stand of data, there were three types of analysis completed for research question one. Those three types were factor analysis, descriptive analysis, and *t*-tests. Factor analysis was conducted to test validity of the survey tool. Three factors emerged. The first factor was grit, the next factor was self-efficacy, and the third factor was social-awareness. Cronbach's alpha was also calculated for each factor to test reliability. Descriptive statistics was used to describe the socio-emotional gender differences found in the data. Finally, the *t*-test analysis was calculated, for each factor, to answer question one which inquired about a statistically significant difference between genders. There was a statistical difference found between genders involving the socio-emotional competence of students, particularly in social-awareness. There were no statistical differences found between grit and self-efficacy.

Research question two was similar to research question one as it utilized the Likert survey. This research question answered the socio-cultural questions of the survey and also included the open-ended survey socio-cultural responses. To demonstrate trustworthiness of the quantitative stand of data for research question two, three types of analyses were conducted. The quantitative portion used factor analysis, descriptive

analysis, and *t*-tests. For factor analysis, two factors were found. The first factor was socio-cultural influences and the second factor was personal focus in STEM. Through factor analysis, the survey was tested for validity. Cronbach's alpha tests were calculated for each factor to test for reliability. Descriptive statistics described the gender differences found in the socio-cultural data. A *t*-test analysis was calculated from both factors which inquired upon the statistically significant differences between genders. There was no significance found between genders regarding socio-cultural influences and personal focus in STEM. In addition, one open-ended socio-cultural survey question was coded via content analysis. This analysis consisted of frequency of responses and percentages.

Research question three shared the results from the seven open-ended questions of the six higher scoring female participants. Responses were shared from the six higher scoring female participants regarding the seven socio-cultural questions. Themes emerged from lean and open coding of the higher scoring participant responses.

Research question four imparted the findings from the six lower scoring female participants. Interview responses from the six lower scoring female participants were shared regarding the seven socio-cultural questions that were asked during interviews. Themes emerged from responses of the six lower scoring female participants through lean and open coding.



## CHAPTER V

### DISCUSSIONS AND CONCLUSIONS

NASA ambassador and actress for the television series *Star Trek*, Nichelle Nichols, has been quoted with: “Science is not a boy’s game, it’s not a girl’s game. It’s everyone’s game. It’s about where we are and where we’re going” (STEM, Law and Civics: Reading and Writing Institute, 2019). The quote provided by Nichols prompts the idea of a need to be involved in STEM to fulfill future STEM needs. This mixed methods explanatory sequential study was conducted to learn more about the socio-emotional competence and socio-cultural influences of middle school students in STEM, in an effort to understand students’ interests in STEM. In this study, student socio-emotional interests were investigated to find the potential significant differences between genders regarding grit, self-efficacy, and social-awareness involving STEM survey questions. Using the STEM survey questions, socio-cultural influences were also explored to find significant differences between genders. Additionally, the socio-cultural perspectives of higher and lower scoring female participants were explored through interviews. Socio-cultural influences from educators, community and family members, peers, parent/guardian, and extracurricular activities were investigated through interviews with the higher and lower scoring female participants.

There were a total of 137 middle school student participants in grades six, seven, and eighth, who agreed to participate in the survey. Of the 137 participants, 73 were male

participants and 64 were female participants. In this mixed methods explanatory sequential study, the 137 students completed a Likert survey to answer the quantitative research questions. Quantitative survey data were used to answer research questions one and two. The quantitative data were also used to find the lowest and highest female participants scores which were then used for the selection of the qualitative participants. This was completed through calculating the means of scores of all female participants and then selecting the two highest scoring female participants from sixth, seventh, and eighth-grade levels and the two lowest scoring female participants from each grade level. These six higher and six lower scoring participants were then interviewed in the qualitative portion to answer research questions three and four. The research questions that guided this study were:

- Q1     Are there significant gender differences in the socio-emotional interests of middle school students (grit, self-efficacy, and social-awareness) found through STEM survey questions?
- Q2     Are there significant gender differences in the socio-cultural influences of middle school students found through STEM survey questions?
- Q3     What socio-cultural perspectives do middle school young women with higher socio-emotional and socio-cultural STEM interests have?
- Q4     What socio-cultural perspectives do middle school young women with lower socio-emotional and socio-cultural interests have?

My theoretical framework drove my research questions. I sought to understand gender equality and its effect at the middle school level, along with the importance of the educator in STEM through care theory at the middle school level, and finally the self-efficacy students had at the middle school level regarding STEM classes. The three frameworks that I have utilized for the study are (a) gender equality (Ropers-Huilman &

Winters, 2011), (b) care theory (Dweck, 2008; Noddings, 2005), and (c) self-efficacy (Bandura, 1997).

This chapter discusses and verifies the findings of the research conducted. For each of the research questions, connections between literature and findings were shared. The contributions to the field, suggestions for future studies, and limitations of the study were discussed. Lastly, final reflections and a concluding summary are found at the end of this chapter.

### **Research Question One**

Research question one utilized the theoretical frameworks from this study to inquire upon gender equality, care theory, and self-efficacy of students in the middle school regarding the focus of socio-emotional interests of students in STEM. Factor analysis was conducted and three factors of grit, self-efficacy, and social-awareness, were named. Descriptive analysis was completed for each factor. In addition, means from each factor, by gender, were used to calculate *t*-tests.

#### **Grit**

For the factor of grit, Cronbach's alpha was calculated to test for internal consistency. When calculated, Cronbach's alpha was reported as 0.66. As this number was below 0.70, it was recommended by McMillan and Schumacher (2001), that this factor be used cautiously. For this factor, since it only contained three items, the calculations for Cronbach's alpha was lower. For descriptive analysis, the calculated means for the Likert survey on grit were 3.32 for male participants and 3.53 for female participants. Grit in STEM was higher for female participants than it was for male participants. However, there was no significant statistical difference found between male

and female participants for grit when using *t*-test analysis. This results suggests that there is not sufficient evidence to conclude that there is a significant difference between male and female participants regarding grit in STEM. For grit, both male and female students scored similarly.

Grit is defined as “perseverance to accomplish long-term or higher-order goals in the face of challenges and setbacks, engaging the student’s psychological resources, such as their academic mindsets, effortful control, and strategies and tactics” (The U.S. Department of Education, Office of Educational Technology, 2013, p. 15). In the classroom, student grit has noticeably decreased, as seen from the results of various journal articles (Credé, Tynan, & Harms, 2017; Fong & Kim, 2019). Grit is important because it is indicated as a mindset that represents student ability for success regarding academic paths (Fong & Kim, 2019). Regarding academic paths, Flanagan and Einarson (2017) explained how grit levels determine success of students in the classroom. This is important as many students connect the grades they earn to success in learning (Usher, Li, Butz, & Rojas, 2019). As the results of no statistical significant difference between genders was similar to recent research, it may also show that work in the classroom regarding grit is successful, regardless of gender (Bowman, Hill, Denson, & Bronkema, 2015; Credé et al., 2017). Lam and Zhou (2019) shared the importance of enhancing student grit levels and how higher grit levels may influence academic achievement, especially in difficult content areas. Wang and Degol (2017) explained the importance of positive learning experiences connecting to positive academic achievement. As the results from this research show grit levels are similar between genders, this may suggest that educators are increasing their time spent on the socio-emotional competence of their

students in the classrooms. The focus on socio-emotional competence in the classroom, particularly of grit, is reinforced by teachers which may help students build stronger grit and that may allow for additional academic achievement in STEM.

### **Self-Efficacy**

Cronbach's alpha was used to test for consistency with self-efficacy. Self-efficacy contained seven items and had a reliability of 0.82 which was above the commonly accepted value of 0.70. Regarding descriptive analysis, self-efficacy showed the least amount of difference between the gender means. Male participants scored a mean of 3.83 and female participants scored a mean of 3.81 for the self-efficacy factor. Using *t*-test analysis, no significant statistical difference was found between genders regarding self-efficacy. These results show that there is not sufficient evidence to conclude that there is a difference between male and female participants regarding self-efficacy when related to the area of STEM.

Self-efficacy is defined by The U.S. Department of Education, Office of Educational Technology (2013) as the "belief in their ability to learn and perform well" (p. 23). Individuals who have strong self-efficacy reach for more difficult goals in their academics (Summers & Falco, 2018). Self-efficacy is often eluded to as the predictor of student success (Bandura, 1997). The findings from this study were different from those of Usher et al.'s research (2019). In the findings of Usher et al. (2019), female students did not score as well as male participants in self-efficacy when focused in the area of mathematics, as this was considered a male dominated content area. In addition, Ropers-Huilman and Winters (2011) shared that female students responded to STEM areas stereotypically, female students explained that they were not as strong as male students

when responding to STEM self-efficacy. It is likely that interventions are taking place in education to help increase interest in STEM, particularly for girls, which may explain the similar results from this research. At the middle school where the study was conducted, female students are often included in STEM girl-only activities, female students work directly with female STEM role models, and female students often have female STEM educators to help build STEM confidence in the classroom. Haley et al., (2017) shared the importance of socio-emotional learning interventions, and results from Falco (2019) suggested that “intervention[s] that can improve participating students’, especially girls’, self-efficacy for math may be particularly valuable in terms of influencing their future engagement in STEM careers” (p. 39).

### **Social-Awareness**

There were eight items in the social-awareness factor. To test for consistency, Cronbach’s alpha was used. Social-awareness scored 0.83 which noted the factor was consistent at over 0.70. Descriptive analysis was used to compare data. Male participants had a mean of 3.70 whereas female participants had a mean of 4.04. For the factor of social-awareness, the female participants mean was higher than the male participant mean. In the *t*-test analysis, there was a statistically significant difference found between male and female participants in regard to social-awareness. The calculation of Cohen’s *d* results indicated a small significance. Hedge’s *g* also was calculated and showed a small significance between male and female participants.

The definition for social-awareness has been described by Peters-Burton and Mattietti (2017) as “a greater understanding of themselves as learners” (p. xxv). Peters-Burton and Mattietti (2017) shared that social-awareness is an ability for student learners

to build self-confidence through individual student learning and reflections and through collaborations with peers. Middle school learning is often collaborative in nature. The collaborative nature of learning has been researched previously showing the importance of making connections through discussions (Huitt & Dawson, 2011). The results from this dissertation are similar to those of a recent study involving gender and social-awareness (Wright, Riedel, Sechrest, Lane, & Smith, 2018). Wright et al. (2018) explained that female students focus on their emotions more than male students and that this may “promote the learning of more fine-grained and detailed emotion[al] concepts/schemas in females” (p. 156). This suggests that female students are making connections to learning in an emotional way. In another study, Kret and De Gelder (2012) stated that women process “...emotional cues from others and [use that] to facilitate communication” (p. 1217). For female students, making emotional connections may be a useful tool for strengthening communication in STEM areas.

In a previous study, Rueger et al. (2010) explained that middle school male students are more supported by peers, than female middle school students, through positive communication and that this was an indicator of STEM success. However, as learned from this research, social-awareness is statistically higher in female students than male students. It is likely that female students are using their emotional cues to communicate with peers in a positive way (Kret & De Gelder, 2012; Wright et al., 2018). The middle school female increase of social-awareness is a positive change. Rueger et al. (2010) shared that social-awareness growth may suggest future STEM success for women. This increase in social-awareness may arise from positive role models, such as teachers in STEM classrooms who model discussion techniques. Social-awareness

changes for female students may also come from other positive role models in female students' lives, such as family members, community members, or professionals in STEM. This transformation in social-awareness may continue to lead to a positive change in STEM interest for female students.

### **Research Question Two**

Research question two examined the gender differences of participant responses and their socio-cultural STEM influences found in middle school. When factor analysis was conducted, there were two factors that were named. Those factors were: socio-cultural influences and personal focus in STEM. Descriptive analysis was completed for each factor. In addition, means from each factor were used to calculate *t*-test. There was also one open-ended question that was used to investigate the encouragement in STEM of middle school students.

#### **Socio-Cultural Influences**

Socio-cultural is defined by Vygotsky (1978) as a method of learning through social interactions of children. Bhargava and Witherspoon (2015) define socio-cultural as a description that includes factors, such as family socio-emotional status, a surrounding neighborhood, social relationships between peers and family, and teacher relationships. Cronbach's alpha was used to test for consistency of socio-cultural influences. There were five items in the factor of socio-cultural influences. The factor scored 0.77 which was above the commonly accepted 0.70, noting that the factor was consistent within the Likert survey. For descriptive analysis, male participants scored a mean of 2.61 and female participants scored 2.77. These mean results were similar between the genders of



participants. Using *t*-test analysis, no significant statistical difference was found between genders regarding socio-cultural influences.

The results from this study support findings from Kahraman and Sungur-Vurals' (2014) study. In their study, no significance between genders was found regarding the socio-cultural influences of students (2014). Kahraman and Sungur-Vural (2014) rationalized that while the socio-cultural influences varied within the population surveyed, the population as a whole valued education. Education is also valued at the middle school where this study was conducted, thus similar results were found and supported. The cultural differences of students, regardless of gender, may change the perspective and focus on student learning in the classroom (Pinxten, 2015). As students collaborate with one another, students are exposed to different cultures through social interactions (Upadhyay et al., 2017; Vygotsky, 1978). Students gain different perspectives from working with students from different cultures and genders, and this can be a beneficial learning environment for all students (Upadhyay et al., 2017).

An interesting observation in the factor of socio-cultural influences, was formed when reviewing the means from the participants in this study. The calculated means from both genders was much lower than other mean results by the middle school participants. This suggested that calculated means from both male and female participants aligned more closely to the "rarely" and "sometimes" responses for participants. The socio-cultural factor inquired upon student participation in STEM and STEM interests. For instance, an example from a question in this factor investigated the likelihood of a student visiting a science museum or speaking with an educator about STEM. It is possible that students at the middle school level were less likely to be interested in visiting STEM

programs or conversing with others about STEM. This disinterest in visiting STEM programs or having conversations about STEM may derive from such activities as constraints on time due to homework, scheduling issues with extracurriculars, and/or potential peer influences eluding STEM activities.

**Personal Focus in Science,  
Technology, Engineering,  
and Mathematics**

A personal focus in STEM can be defined as an individual disposition in the content areas of STEM. The factor for personal focus in STEM contained five items and had a calculated Cronbach's alpha of 0.74, which was above the commonly accepted 0.70, noting consistency within the Likert survey. For descriptive analysis, male participants scored a mean of 3.61 and female participants scored 3.68 for the calculated mean. The calculated mean results were similar between genders. When using *t*-test analysis, there was no statistical significant difference found between participant genders in personal focus in STEM.

Research exploring personal focus in STEM at the middle school is absent. However, in a similar research study involving high school students, Eccles and Wang (2016) investigated the self-concepts and career aspirations of students studying STEM and noted a difference between genders. Their study explained that "males in our study rated their level of math ability self-concept higher and level of people orientation lower than females at 12<sup>th</sup> grade" (Eccles & Wang, 2016, p. 104). Female participants perceived the importance of family versus work differently than male participants and this suggested that gender stereotypes in STEM were present (Eccles & Wang, 2016). Eccles and Wang (2016) explained that female participants noted the lack of time available for

family needs when working in a STEM career and compared that to non-STEM careers. This comparison between STEM and non-STEM careers may have negatively changed female personal focus in STEM. Similarly, in a study by Dorph, Bathgate, Schunn, and Cannady (2018), gender difference was found between the personal focus of high school students in STEM. Dorph et al. (2018) explained that “being male is associated with higher affinity scores for each STEM career option...[but] being female is associated with less certainty about one’s career goals...” (p. 1051).

The personal focus in STEM for those high school students is different from the results found from this study involving middle school students (Dorph et al., 2018). As the results of this study suggest, both male and female middle school students have similar personal focuses in STEM areas. Results from this research may be supported by STEM educators. Many STEM educators attempt to strengthen student dispositions in the STEM areas through STEM experiences and STEM conversations, regardless of gender. This similarity in personal focus in STEM, found between genders, may suggest positive growth for female students regarding their interest in STEM. There are various ways that middle school females may be increasing their personal focus in STEM. For instance, there are female only STEM programs/activities, influences from female STEM teachers, learning impacts from maternal and paternal conversations and observations involving STEM, positive peer interactions around STEM, and extracurricular student activities in STEM areas.

### **Encouragement in Science, Technology, Engineering, and Mathematics**

To explore the differences between genders of the socio-cultural influences of middle school students, the survey contained one open-ended question to investigate encouragement in STEM areas. There were some similarities and differences. For instance, male participants were mostly influenced by teachers with 67.1% versus female participants who were influenced by teachers with 65.6%. Male participants were then influenced by parents/guardians with 19.2% whereas female participants were influenced by parents/guardians with 31.3%. Male participants were the only participants to also be influenced by themselves with 11.0%.

Both genders noted that teachers were the most influential regarding encouragement in STEM. This amount of influence signifies the importance of the teacher and student relationship, connecting to the idea of care theory (Noddings, 2005). In the study by Kahraman and Sungur-Vural (2014), the importance of educator influence can be seen through the idea of “students who perceive mastery goals from their teachers tend to place more value on learning new skills than students who perceive performance goals from their teachers” (p. 40).

There is one difference between male and female participants regarding additional influences in STEM. Male participants shared that they were encouraged by parents/guardians at a lower amount than females students. Male participants also had an added encouragement by self that female students did not. This may suggest that some male participants are more confident in their STEM skills than some of their female peers. This is similar to the results seen in the study by Sadler et al. (2012). In addition,

Genareo, Mitchell, Geisinger, and Kemis (2016) shared in their study that male participants showed more interest and confidence in STEM areas at the middle school level.

### **Research Questions Three and Four**

The qualitative portion of this dissertation sought to answer research questions three and four. Using the Likert scale survey responses, the six highest female participants were interviewed for research question three. Also using the Likert scale survey responses, the six lowest scoring female participants were interviewed regarding research question four. The socio-cultural perspective themes of the six higher socio-emotional and socio-cultural scoring female responses were compared with those of the lower socio-emotional and socio-cultural scoring female responses. Similarities and differences between the higher and lower scoring female participants can be seen through the themes in the table below (see Table 26).

Table 27. Higher and lower scoring female participant themes

Interview Question	Higher Scoring Female Participant Theme	Lower Scoring Female Participant Theme
1. Influences regarding STEM careers	Educators influencing STEM careers (Sub Theme) Influences from family	Educators influencing STEM careers
2. Personal connections to STEM professions	Greater connection to STEM professionals	Less connection to individuals in STEM
3. Impressions of STEM careers	Details about STEM increase as grade levels increase	Simplified ideas of STEM
	Positive peer interest in STEM	Less peer interest in STEM
	Strong self-efficacy in STEM	Disinterest and lesser self-efficacy for STEM
	Positive STEM influences from teachers and everyday culture	Mixed STEM influences from teachers and individuals
4. Gender biases in STEM and male peer perceptions on STEM	Acknowledgment of gender bias	Mixed opinions on gender bias in STEM
	Male peer attitudes differ from female peer attitudes	No difference in STEM perceptions or attitudes of male peers
5. Peer influences	Close peers have similar influences and interests	Relationships with peers decide interest in STEM activities
6. Parent/guardian influences	Parental encouragement for educational success	Parental guidance regardless of interest in STEM, for educational success
7. Extracurricular interests and STEM	Extracurricular activities lead to educational success	No connection between extracurricular interests and STEM

### **Influences Regarding Science, Technology, Engineering, and Mathematics Careers**

Both higher and lower scoring female participants denoted themes that showed the importance of influences from educators towards STEM careers. The relationship between a student and teacher has been explored in care theory, often suggesting the stronger the relationship between student and teacher, the more likely the student desires to learn. Noddings (1995) has explained:

My contention is, first, that we should want more from our educational efforts than adequate academic achievement and, second, that we will not achieve even that meager success unless our children believe that they themselves are cared for and learn to care for others (pp. 675-676).

Furthermore, Nugent et al. (2015) shared the opinion that “Educators who consciously try to actively engage their students and positively impact their attitudes toward STEM subjects can have far-reaching impacts” (p. 1082). Additionally, Prewett, Bergin, and Huang (2019) noticed that “Given the importance of relationships for student well-being...teachers should attempt to foster good relationships with their students” (p. 80). Both participant groups reiterated the importance of educators regarding STEM.

The higher scoring female participant group also shared an additional theme not found in the lower scoring group. This theme was influences from family. The importance of parent encouragement has been found to positively affect student learning (Kahraman & Sungur-Vural, 2014). The higher scoring female participants acknowledged the support of parents and shared how family had positively influenced them in their academic goals.

### **Personal Connections to Science, Technology, Engineering, and Mathematics Professions**

The higher scoring and lower scoring female participants had inconsistent themes regarding their connections to STEM professions. Higher scoring female participants knew of professionals in STEM who had impacted their lives, either from parents or family members. However, lower scoring female participants had lesser connections with individuals in STEM. There were three lower scoring female participants that believed they knew someone with a STEM career but had not had conversations with them to confirm their STEM careers. Only one lower scoring female participant knew of a specific role in STEM that her father held and had a conversation with him about it. Baran, Canbazoglu Bilici, Mesutoglu, and Ocak (2019) shared the importance of increasing STEM engagement. Their study explained that interest grew when students worked with professionals to understand daily-ins and outs of STEM fields (Baran et al., 2019). This suggests that students who have access to individuals in STEM are more likely to have a favorable disposition and/or understanding of STEM professions.

### **Impressions of Science, Technology, Engineering, and Mathematics Careers**

There were four themes found from the higher scoring and lower scoring female participants. These themes differed between the higher and lower scoring participants. Each of these themes is discussed further.

Higher scoring female participants had a greater understanding of what STEM careers were. Their ideas became more detailed as their grade level increased. For instance, sixth-grade responses were simpler, seventh-grade responses were more



detailed, and finally the eight-grade responses were in depth. This differed from the lower scoring female participants whose main ideas about STEM stayed the same, regardless of grade level. Most responses from lower scoring female participants regurgitated the acronym for STEM. Dewey (1910) suggested that the more details individuals shared regarding a concept, the more connection to that information the individual had. Dewey (1910) shared in *My Pedagogic Creed*, that:

I believe that the school is primarily a social institution. Education being a social process, the school is simply that form of community life in which all those agencies are concentrated that will be most effective in bringing the child to share in the inherited resources of the race, and to use his own powers for social ends (p. 8).

The next theme of this question involved students' impressions on how they felt their peers were engaged in STEM. For the higher scoring female participants, positive peer impressions were shared. However, the lower scoring female participants noticed fewer peers were interested in STEM. As students' social-awareness and collaboration skills are as in tune as they are for female middle school students (Huitt & Dawson, 2011), it is possible that these higher and lower scoring participants followed the impressions of their peers. For instance, according to lower scoring female participants, it was more socially acceptable to like STEM areas if close peers were also interested in those areas or less socially acceptable if peers were disinterested in STEM areas.

Student self-efficacy regarding impressions of STEM careers became important in the next theme. Higher scoring female participants shared positivity regarding STEM and signified strong self-efficacy in the areas of STEM. However, the lower scoring female

participants showed disinterest and lower self-efficacy in their interest in STEM areas. Strong self-efficacy is important for individuals going into STEM, as self-efficacy may denote successful opportunities in STEM areas (Ropers-Huilman & Winters, 2011).

The final theme for this question involved the influences female participants had from their educators and surrounding culture. The higher scoring female participants shared that they had positive influences from educators. Educators had taken higher scoring female students on STEM trips and those students had formed positive memories associated with STEM. The higher scoring participants also acknowledged everyday cultural stereotypes in STEM careers. For instance, one of the higher scoring female participants shared that when she was younger, cultural stereotypes suggested that STEM was only for boys. She continued to explain that those viewpoints were changing and may have been older ideas due to new resources and activities for girls like STEM sponsored days for girls. This positive viewpoint shows a potential change in STEM cultural stereotypes for females.

Lower scoring female participants shared mixed influences from educators and stereotypes associated with STEM careers. The lower scoring female participants shared that teachers had tried to influence them towards engagement in STEM, but they did not maintain positive memories from those experiences or from those classes. These ideas are supported by Kahraman and Sungur-Vural (2014) who shared that “Concerning the educational domains...math and science subjects are known as male dominant, social subjects are known as female dominant subjects” (p. 33). Lower scoring female participants shared the idea that gender stereotypes are current in STEM and are not likely to change in the foreseeable future. For instance, a lower scoring participant

explained that engineering was a male dominated career in STEM and the reason for that had to do with male influences from male teachers. She continued to share that because of this, her close peers were less likely to be interested in engineering.

**Gender Biases in Science, Technology, Engineering, and Mathematics and Male Peer Perceptions on Science, Technology, Engineering, and Mathematics**

There were two themes regarding gender bias in STEM and male peer perceptions in STEM, found from the higher and lower scoring female participants. Similar, yet different, the higher and lower scoring female participants each had an understanding of gender biases in STEM. Higher scoring participants acknowledged there were gender biases in STEM, however, they explained that those biases were changing and dated. The perspective of dated and changing STEM biases differed from the perspectives of the lower scoring female participants. The lower scoring female participants noted that there were gender biases in STEM. For instance, a lower scoring female participant, explained that she felt STEM was for boys and suggested that anyone could do STEM but explained that girls were not as likely to be interested in STEM. Another lower scoring female participant shared a similar response suggesting that some roles in STEM were more conducive to boys because boys like to get their hands dirty while girls do not. The responses from the higher scoring female participants in this study support research conducted by Cheryan et al. (2017). According to Cheryan et al. (2017), STEM influences are strengthened for girls when they are influenced by role models and also when they take into account outside influences such as gender stereotypes in STEM. When female-only programs or activities are organized for students, often times female

role models in STEM address gender stereotypes and explain how they have persevered through gender stereotypes. These opportunities may be positively influencing female students who participate in studying STEM content areas.

However, the lower scoring female participant responses aligned similarly to the results from Farrell and McHugh (2017). In the research conducted by Farrell and McHugh (2017), results indicated that female students shared that a gender bias currently exists in STEM. In their study, female students explained that male students were stronger than female students in the areas of STEM (Farrell & McHugh, 2017). These gender biases are sometimes modeled through conversations with family members (Eccles & Wang, 2016). Eccles and Wang (2016) explained how females consider family values before pursuing STEM roles:

The effect of family values on STEM occupational choices was only evident for females. This could reflect the fact that females, even in dual earner families, still put more time into family chores than do males, and they may believe that being in a STEM field will make it harder to fulfill their prescribed roles within the family (p. 104).

The lower scoring female participants may have had conversations regarding ideal family values. They may have then compared those family values with future goals in STEM and decided that a STEM career would not be feasible for them.

For the next theme, involving the classroom, higher scoring female participants noted that male classmates and female classmates' attitudes in STEM learning differed. For instance, a higher scoring female participant shared that she noticed that boys did not pay attention in class but that girls did. The opinions of the higher scoring female

participants are similar to the research conducted by Genareo et al. (2016), where a difference in STEM interest was seen in the middle school grades. Genareo et al. (2016) explained that there was greater STEM learning interest from female students as compared to male students. This may suggest that the higher scoring female participants are more observant and aware of the social constructs of the classroom due to their higher STEM learning interest. The higher scoring female participants may also understand the importance of ignoring distractors in the classroom in order to be a successful student in STEM. Whereas, lower scoring female participants did not see much of a STEM learning difference between male classmates and female classmates. This may suggest that the lower scoring female participants are less aware of the social constructs of the classroom and may see all individuals, regardless of distractors of peers, the same.

### **Peer Influences**

Nugent et al. (2015) suggested that peer groups have less of an effect on STEM influence, the results from the themes of peer influences in this study show a differing opinion. Higher scoring female participants noted that their close friends had similar influences and interests towards STEM. However, the lower scoring participants suggested that the relationships they have with their closest peers determine their interest in activities, such as STEM. For lower scoring female participants, if they had peers who were not interested in STEM, they would also not be interested in STEM. Using Bandura's (1997) self-efficacy ideas, the higher scoring female participants were more likely to have higher beliefs in their STEM abilities and sought out peers who had similar beliefs. As a result, the higher scoring female participants found positive peer groups who were involved in similar interests. Whereas the lower scoring female participants may

have had lower perceptions of their abilities in STEM and were more likely to following their peers' influences.

### **Parent/Guardian Influences**

Nugent et al. (2015) suggested that parents/guardians organize and plan for their children's interests in education and are likely to support their learning. The themes parent/guardian influences differed between higher and lower scoring female participants. The higher scoring female participants shared that their parents/guardians encouraged educational success. Kahraman and Sungur-Vural (2014) explained "students who think that their parents give priority to improvement of knowledge and skills in science tend to perceive science activities as interesting, useful, or enjoyable" (p. 40). Furthermore, Dorph et al. (2018) shared "increases in home resources are associated with modest increases in math affinity" (p. 1051). It is likely that the higher scoring female participants had been supported by their parents/guardians regarding STEM learning. Whereas, lower scoring female participants shared that general parent/guardian guidance in their learning occurred but that it was not always associated with STEM influences. While parents/guardians guided their students towards educational success, it seems that the lower scoring female participants were less influenced to pursue STEM careers by their parents/guardians.

### **Extracurricular Interests and Science, Technology, Engineering, and Mathematics**

The higher and lower scoring female participants had differing opinions of how extracurricular activities were connected to their STEM interests. For the higher scoring

female participants, opportunities to learn outside of the classroom in STEM had positively influenced their educational successes. One higher scoring female participant shared how she became interested in medicine after an injury from a teammate in softball. Nugent et al. (2015) explained how extracurricular interests served as opportunities outside of the classroom setting to engage and interest students without time constraints leading to additional support in STEM areas. Alternatively, lower scoring female participants did not see any connection between extracurricular activities and STEM. For example, one lower scoring female participant shared how dance had influenced her time management skills, but she had not inquired further regarding a connection to STEM and her extracurricular activities.

### **Contributions to the Field**

As STEM positions are struggling to be filled, a necessary, continued effort in engaging students towards STEM fields needs to take place. In the classroom, as students continue to focus on content, there is also a need to fulfill the learning of the whole student. Increasingly important is the role of socio-emotional and socio-cultural learning and how it supports student growth amongst difficult tasks. This study investigated the socio-emotional interests and socio-cultural influences of students in STEM. As this study was an explanatory sequential design, mixed method processes were used to answer research questions. The information gained from this study has added to the understanding of the socio-emotional interests and socio-cultural influences of middle school students, which suggest the need to strengthen student/teacher relationships while also building positive socio-emotional interest and socio-cultural influences to increase the likelihood of female students pursuing careers in STEM fields.

Education is a field that undertakes change to adapt and reach our students. This dissertation focused upon the socio-emotional competence and socio-cultural influences in STEM which is an area of interest for reform in education. This study can be applied to other grade levels, to other groups of learners besides gender, and to different populations. There are five key ideas provided by this dissertation:

1. Social-awareness was found to be significantly different for female and male students at the middle school level in this study. This is important for educators to know as this helps decipher the engagement, academic lessons, and learning differentiation necessary to reach both female and male students in STEM areas. Using the results of this research, educators who work with female students can use a focus of social-awareness to share STEM interests. For instance, educators can highlight collaboration in STEM, working and caring for others in various STEM roles, and sharing information on STEM careers.
2. Classroom teachers need to be cognizant of their influences in the classroom. Male middle school students reported being influenced by teachers at 67.1% and female students reported influences by teachers at 65.6%. Additionally, higher scoring female participants noted the importance of teachers in their educations and connected this to their interests in STEM whereas lower scoring female participants noted an absence of connectedness of teachers in their educations and shared less interest in STEM. It is important for teachers to build positive relationships with students so that their students feel comfortable and gain greater learning experiences, particularly for experiences in STEM. Through positive



influences from educators, students may develop stronger self-efficacy in STEM which can lead to greater interest in a STEM career.

3. Positive learning experiences in STEM allow for higher engagement and increase interest levels of students. Introducing extracurricular activities for students involving STEM professionals or STEM activities at the middle school level or earlier, may help students to comprehend the real-world problems, build self-confidence, and allow for additional relationships with professionals as seen from the responses of the higher scoring female participants. However, less student interaction with STEM extracurricular activities showed overall less interest in STEM as seen from the lower scoring female participants in this study. Through extracurricular programs in STEM, there are opportunities for students to build relationships which may build positive interactions with professionals in STEM. Teachers should aim to encourage their students with STEM trips, STEM camps, and different STEM activities to positively encourage STEM learning experiences.
4. Parents/guardians also have an important role in encouraging their children in STEM. Parents/guardians may encourage their children towards academic success by giving them more opportunities to explore STEM areas, meet with STEM professionals, and/or to build up their children's confidences in STEM through various competitions. It is through these enriching activities that their children will gain additional interests in STEM outside of the classroom.
5. The higher scoring female participants shared the importance of like-minded and STEM interested peer groups. The higher scoring female participants shared how

positive peer groups allow for competition between individuals that can help individuals realize their highest potentials. This is compared to the lower scoring female participants who were more likely to follow their peers' influences. When students find positive peer influences, they also build self-confidence and interests in STEM. Parents/guardians, school administrators, and teachers should encourage STEM clubs/groups in school settings, STEM activities could be arranged outside of school times for students to meet up and explore, and students should be prompted to attend engaging STEM camps/activities/programs involving students in similar age groups.

### **Suggestions for Future Studies**

Research often leads to new questions that in time will need to be studied. This can occur when data is under covered while investigating. Creswell (2012) explained that suggestions for future studies are new ideas to advance future educational fields. Four suggestions for futures studies are provided.

First, the findings of this research note a statistically significant difference between genders regarding social-awareness at the middle school level. Future research should investigate social-awareness and STEM at different educational levels such as elementary and high school. Questions for exploration may include: how does female social-awareness at varying grade levels affect their interest in STEM areas and what differentiation should educators use to improve upon engaging students regarding their varying social-awareness?

An additional area for future research may involve studying male and female participants in a longitudinal study from elementary school, through middle school, and

into high school levels. This research would continue to address student socio-emotional interests and socio-cultural influences in STEM. This long term research may provide additional information on grit, self-efficacy, social-awareness, influences of educators, influences of peers, influences of parents/guardians, and influences of extracurricular interests involving STEM. Questions for this longitudinal study may involve: how do STEM socio-emotional interests and socio-cultural influences evolve from elementary through high school levels, what potential changes in socio-emotional interests and socio-cultural influences may engage students in STEM careers, and what potential changes in socio-emotional interests and socio-cultural influences may disengage students in STEM careers?

Another area of research may come from continued research involving students of different socioeconomic status and race than what had been researched in this study. This would allow for a broader perspective of data which would apply to continued research in STEM. Questions for this study may inquire upon what perspectives students have in STEM with different socioeconomic statuses, what socio-cultural influences students have with different socioeconomic statuses, and what socio-emotional competencies students have with different socioeconomic statuses?

Finally, another area for continued research may involve the socio-emotional and socio-cultural survey inquiring upon individual STEM content areas responses. This would allow for connections between socio-emotional interests and socio-emotional competence at each of the content areas as compared to STEM as a whole. Questions for further exploration may include: what differences exists between socio-emotional interests and socio-cultural influences regarding science at the middle school level, what

differences exists between socio-emotional interests and socio-cultural influences regarding technology at the middle school level, what differences exists between socio-emotional interests and socio-cultural influences regarding engineering at the middle school level, and what differences exists between socio-emotional interests and socio-cultural influences regarding mathematics at the middle school level?

### **Limitations of the Study**

Creswell (2012) described limitations as a potential weakness that is found by the researcher. All research does have some limitations. Limitations are helpful to future researchers who may consider similar studies as they determine what extent findings “can or cannot be generalized to other people and situations” (Creswell, 2012, p. 199). Four limitations of this study are provided.

The first limitation associated with this study involves sample size. Initially, there were many more parents/guardians who had given approval for their student to participate in the Likert survey. However, by the time students had consented to participate, many students chose to cancel or stop the survey due to the length of the Likert survey. While 137 (73 male and 64 female) participants seems like a large number, I had initially hoped to work with 200 participants (100 male and 100 female) to allow for even opinions between male and female students.

The next limitation involved the population of students. I chose to only survey and interview within one district that I know and am involved in, which allowed for a sense of security for parents/guardians. However, it also limited the student population to only one midwestern upper middle-class school. Involving a more diverse group of participants from various middle schools may have concluded with differing results.

Another limitation was be my dual roles as a teacher and a researcher in this study. As this study was conducted in the school that I was employed with, there was a balance that was needed in both the roles of teacher and researcher. First and foremost, participants were likely to participate knowing that I was a member of the staff. Even students who I did not have in class would approach me to ask questions for the purpose of the study they were interested in participating. Next, the number of participants in the grade level that I taught were higher than other two grade levels. This may have been due to students feeling more comfortable and/or felt more obligated to participate because they knew me. Also, as a teacher, the research I gained. Also, as a teacher, the research used for my study had an immediate impact on my teaching. Engagement has always been a very important tool in my classroom but further became the most important focus of my lessons in an effort to connect students to science in the hopes of helping to solidify interest in STEM.

The last limitation arises from the focus of STEM in this dissertation. Examining the socio-emotional interests and socio-cultural influences of each content area (science, mathematics, engineering, and technology) separately would have been a valuable tool to analyze regarding gender and the interest of participants. However, as the Likert survey was written, students did not assess socio-emotional interests and socio-cultural influences to individualized content areas. Due to this, students set an overall opinion of socio-emotional interests and socio-cultural influences in all four STEM subjects instead of the individual subject.

### **Final Reflections**

Every day, new discoveries are broadcasted and published in the STEM fields. Lab scientists are racing towards cures for cancer while engineering students are simulating alternative tissues through common, everyday appliances in an effort to reduce cost and waste. As an educator, I wonder if I am engaging and influencing students enough to encourage them to embark upon a future in STEM for their career aspirations. In this research, I focused on gender differences at the middle school level after conducting much research that supported middle school as the make or break time in a student's life allowing for interest or disinterest in STEM. I was not sure how students would react to being asked to complete a large survey or how they would react to being asked for an interview. However, I was pleased with student interest in the research. I was also very excited to learn about student socio-emotional interest levels along with student socio-cultural influences.

I also enjoyed working with the higher and lower scoring female participants in interviews. Following interviews, students would contact me asking for more information about STEM opportunities, as often times the interviews we shared allowed for a renewed engagement in STEM interest. Perhaps the conversations even allowed for relationships to build between the participant and interviewer as students felt comfortable seeking out assistance regarding STEM areas (Noddings, 2005). Each of the middle school female participants was also very curious about the doctoral program and dissertation process. I am hopeful that the opportunity to participate in this dissertation may have inspired some female participants to pursue their doctoral education.

I feel that the sequential explanatory mixed methods design was the best methodology for this research. The mixed methods information allowed for difficult and

immense amounts of data to be collected and organized. The use of the quantitative portion of the results helped me to select female participants for the qualitative portion of the research.

I am hopeful that this research may help to reform STEM education by focusing on the socio-emotional competence and socio-cultural interests of middle school students and the differences between genders. This research provided suggestions to increase both female and male interest and engagement in STEM. I am confident that this study will contribute new professional developments for educators to help ensure relationships are built between the student and educator through focusing on the socio-emotional interests and socio-cultural influences in STEM for middle school students.

### **Summary**

This chapter served as a final discussion of research results and findings. The results for each of the four research questions were connected to relevant research and conclusions. For the quantitative portion of the discussion, research question one addressed discussions of the three factors: grit, self-efficacy, and social-awareness. Research question two discussed the two factors: socio-cultural influences and personal focus in STEM. For the qualitative portion of the discussion, involving research questions three and four, themes from the higher scoring and lower scoring female participants were compared. To close, also included in this chapter are contributions of the study to the field, suggestions for future studies, limitations of the study, and a final reflection.

## References

- Adams, P. (2007). Exploring social constructivism: Theories and practicalities. *Education 3-13: International Journal of Primary, Elementary and Early Years Education*, 34(3), 243-257. doi: 10.1080/03004270600898893
- Aelenei, C., Darnon, C., & Martinot, D. (2017). Boys, girls, and the school cultural environment: Teachers' judgment and students' values. *The Journal of Social Psychology*, 157(5), 556-570. doi: 10.1080/00224545.2016.1243514
- American Association of University Women. (1991). *Shortchanging girls, shortchanging America* [Motion picture on VHS].
- American Association of University Women. (2010). *Why So Few? Women in science, technology, engineering, and mathematics (STEM)*. Hill, C., Corbett, C., & Rose, A. Washington, DC: Author. Retrieved from <https://www.aauw.org/research/why-so-few/>
- Archer, L., Dawson, E., DeWitt, J., Seakins, A., & Wong, B. (2015). "Science capital": A conceptual, methodological, and empirical argument for extending bourdieusian notions of capital beyond the arts. *Journal of Research in Science Teaching*, 52(7), 922-948.
- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science aspirations, capital, and family habitus how families shape children's engagement and identification with science. *American Educational Research Journal*, 49(5), 881-908.
- Ary, D., Jacobs, L. C., Sorensen, C. K., & Walker, D. A. (2013). *Introduction to research in education* (9th ed.). Belmont, CA: Wadsworth Cengage Learning.



- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Baran, E., Canbazoglu Bilici, S., Mesutoglu, C., & Ocak, C. (2019). The impact of an out-of-school STEM education program on students' attitudes toward STEM and STEM careers. *School Science and Mathematics, 119*(4), 223-235.  
doi:10.1111/ssm.12330
- Bardach, L., Lüftenegger, M., Yanagida, T., Schober, B., & Spiel, C. (2019). The role of within-class consensus on mastery goal structures in predicting socio-emotional outcomes. *British Journal of Educational Psychology, 89*(2), 239-258.  
doi:10.1111/bjep.12237
- Benbow, C., Lubinski, D., Shea, D., & Eftekhari-Sanjani, H. (2000). Sex differences in mathematical reasoning ability at age 13: Their status 20 years later. *Psychological Science, 11*(6), 474-480. Retrieved from <http://www.jstor.org.unco.idm.oclc.org/stable/40063619>
- Bhargava, S., & Witherspoon, D. P. (2015). Parental involvement across middle and high school: Exploring contributions of individual and neighborhood characteristics. *Journal of Youth and Adolescence, 44*(9), 1702–1719.  
doi: 10.1007/s10964-015-0334-9.
- Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development, 78*(1), 246-263.  
doi:10.1111/j.1467-8624.2007.00995.x
- Blaikie, N. (2003). *Analyzing quantitative data: From description to explanation*. London: SAGE.

- Bloom, B. S. (1956). *Taxonomy of educational objectives: the classification of educational goals*. Green, New York: Longmans.
- Bloomberg, L. D., & Volpe, M. (2016). *Completing your qualitative dissertation: A roadmap from beginning to end*. Los Angeles, CA: Sage Publications, Inc.
- Bowman, N. A., Hill, P. L., Denson, N., & Bronkema, R. (2015). Keep on truckin' or stay the course? Exploring grit dimensions as differential predictors of educational achievement, satisfaction, and intentions. *Social Psychological and Personality Science*, 6(6), 639-645. doi:10.1177/1948550615574300
- Brass, N., McKellar, S. E., North, E. A., & Ryan, A. M. (2019). Early adolescents' adjustment at school: A fresh look at grade and gender differences. *The Journal of Early Adolescence*, 39(5), 689-716. doi:10.1177/0272431618791291
- Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching*, 43(5), 485-499.
- Brody, L. E., & Mills, C. J. (2005). Talent search research: What have we learned? *High Ability Studies*, 16(1), 97-111. doi:10.1080/13598130500115320
- Buchanan, T., & Selmon, N. (2008). Race and gender differences in self-efficacy: Assessing the role of gender role attitudes and family background. *Sex Roles*, 58(11), 822-836. doi:10.1007/s11199-008-9389-3
- Buffington, J. (2016). *Frictionless markets: The 21st century supply chain*. Cham: Springer.
- Bybee, R. W. (2013). *Case for stem education: Challenges and opportunities*. Arlington, VA: National Science Teachers Association. Retrieved from <https://ebookcentral.proquest.com>

- Carnegie Council on Adolescent Development. (1989). *Turning points: Preparing American youth for the 21st century*. New York, NY: Carnegie Corporation.
- Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why are some stem fields more gender balanced than others? *Psychological Bulletin*, 143(1), 1-35.  
doi:10.1037/bul0000052
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, N.J: L. Erlbaum Associates.
- Cohen, W. (1967). Education and learning. *The Annals of the American Academy of Political and Social Science*, 373, 79-101. Retrieved from  
<http://www.jstor.org.unco.idm.oclc.org/stable/1037354>
- Collaborative for Academic, Social, and Emotional Learning. (2018). What is SEL?  
Retrieved from <https://casel.org/what-is-sel/>
- Constable, G., & Somerville, B. (2003). *A century of innovation: Twenty engineering achievements that transformed our lives*. Washington, D.C: Joseph Henry Press.
- Coskun, K. (2019). Evaluation of the socio emotional learning (SEL) activities on self-regulation skills among primary school children. *The Qualitative Report*, 24(4), 764-780.
- Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation*, 10(7), 1-9.
- Credé, M., Tynan, M., & Harms, P. (2017). Much ado about grit: A meta-analytic synthesis of the grit literature. *Journal of Personality and Social Psychology*, 113(3), 492-511. doi:10.1037/pspp0000102

- Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, Calif: Sage Publications.
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston: Pearson.
- Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage Publications, Inc.
- Curlee, A. S., Aiken, L. S., & Luthar, S. S. (2018). Middle school peer reputation in high-achieving schools: Ramifications for maladjustment versus competence by age 18. *Development and Psychopathology*, 30(3), 1-15.  
doi:10.1017/S0954579418000275
- Devis-Rozental, C. (2018). *Developing socio-emotional intelligence in higher education scholars*. Cham, Switzerland: Palgrave Macmillan.
- Dewey, J. (1910). *My pedagogic creed*. Chicago: A. Flanagan company.
- Dorph, R., Bathgate, M. E., Schunn, C. D., & Cannady, M. A. (2018). When I grow up: The relationship of science learning activation to STEM career preferences. *International Journal of Science Education*, 40(9), 1034-1057.  
doi:10.1080/09500693.2017.1360532
- Drew, D. E. (2015). *Stem the tide: Reforming science, technology, engineering, and math education in america*. Baltimore, MD: Johns Hopkins University Press.
- Duckworth, A. L. (2016). *Grit: The power of passion and perseverance*. New York, NY: Scribner.

- Duckworth, A. L., & Gross, J. J. (2014). Self-control and grit: Related but separable determinants of success. *Current Directions in Psychological Science*, 23(5), 319-325.
- Duckworth, A. L., Kirby, T. A., Tsukayama, E., Berstein, H., & Ericsson, K. A. (2011). Deliberate practice spells success: Why grittier competitors triumph at the National Spelling Bee. *Social Psychological and Personality Science*, 2(2), 174-181. doi: 10.1177/1948550610385872
- Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, 92(6), 1087-1101.
- Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (GRIT-S). *Journal of Personality Assessment*, 91(2), 166-174. doi: 10.1080/00223890802634290
- DuFour, R., & Eaker, R. E. (1998). *Professional learning communities at work: Best practices for enhancing student achievement*. Alexandria, Va; National Education Service.
- Durović, M. (2016). Social responsibility and self-governance by the scientific community. *Cadmus*, 2(6), 13-19.
- Dweck, C. S. (2007). The Perils and Promises of Praise. *Educational Leadership*, 65(2), 34-39.
- Dweck, C. S. (2008). *Mindsets and math/science achievement*. New York, NY: Carnegie Corp. of New York-Institute for Advanced Study Commission on Mathematics and Science Education.

- Dweck, C. S., & London, B. (2004). The role of mental representation in social development. *Merrill - Palmer Quarterly*, 50(4), 428-444. Retrieved from <https://unco.idm.oclc.org/login?url=https://search-proquest-com.unco.idm.oclc.org/docview/230093367?accountid=12832>
- Ebadi, S., & Gheisari, N. (2016). The role of consciousness-raising through critical reflection in teachers' professional development: A sociocultural perspective. *Cogent Education*, 3(1), 1-14. doi:10.1080/2331186X.2016.1147990
- Eccles, J., & Wang, M. (2016). What motivates females and males to pursue careers in mathematics and science? *International Journal of Behavioral Development*, 40(2), 100-106. doi:10.1177/0165025415616201
- Edmundson, M. (2002). *Teacher: The one who made the difference (1st ed.)*. New York: Random House.
- Egbert, J., & Sanden, S. (2014). *Foundations of education research: Understanding theoretical components*. New York, NY: Routledge.
- Einarsson, C., & Granström, K. (2002). Gender-biased interaction in the classroom: The influence of gender and age in the relationship between teacher and pupil. *Scandinavian Journal of Educational Research*, 46(2), 117-127. doi:10.1080/00313830220142155
- Falco, L. D. (2019). An intervention to support mathematics self-efficacy in middle school. *Middle School Journal*, 50(2), 28-44. doi:10.1080/00940771.2019.1576580

- Farrell, L., & McHugh, L. (2017). Examining gender-stem bias among STEM and non-stem students using the implicit relational assessment procedure. *Journal of Contextual Behavioral Science*, 6(1), 80-90. doi:10.1016/j.jcbs.2017.02.001
- Flanagan, K. M., & Einarson, J. (2017). Gender, math confidence, and grit: Relationships with quantitative skills and performance in an undergraduate biology course. *CBE Life Sciences Education*, 16(3), 1-11. Retrieved from <http://doi.org.unco.idm.oclc.org/10.1187/cbe.16-08-0253>
- Fong, C. J., & Kim, Y. W. (2019). A clash of constructs? Re-examining grit in light of academic buoyancy and future time perspective. *Current Psychology*, 38(1), 1-14. doi:10.1007/s12144-018-0120-4
- Forbes, B. C. (1921). Why do so many men never amount to anything? *The American Magazine*, 91(1). Retrieved from <https://catalog.hathitrust.org/Record/000598163>
- Friedman, T. L. (2007). *The world is flat: A brief history of the twenty-first century* (1st ed.). New York: Picador/Farrar, Straus and Giroux.
- Gates, B. (2005). Bill gates - national education summit on high schools [Press release]. Retrieved from <https://www.gatesfoundation.org/media-center/speeches/2005/02/bill-gates-2005-national-education-summit>
- Gehlbach, H., Brinkworth, M. E., Hsu, L., King, A., McIntyre, J., & Rogers, T. (2016). Creating birds of similar feathers: Leveraging similarity to improve teacher-student relationships and academic achievement. *Journal of Educational Psychology*, 108(3), 342-352.

- Genareo, V. R., Mitchell, J., Geisinger, B., & Kemis, M. (2016). University science partnerships: What happens to STEM interest and confidence in middle school and beyond. *K-12 STEM Education*, 2(4), 117-127.
- Glesne, C. (1999). *Becoming qualitative researchers: An introduction* (2nd ed.). New York: Longman.
- Grant, H., & Dweck, C. S. (2003). Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology*, 85(3), 541-553.
- Greenberg, M. T., Domitrovich, C. E., Weissberg, R. P., & Durlak, J. A. (2017). Social and emotional learning as a public health approach to education. *The Future of Children*, 27(1), 13-32.
- Grossman, J. M., & Porche, M. V. (2014). Perceived Gender and Racial/Ethnic Barriers to STEM Success. *Urban Education*, 49(6), 698–727.  
<https://doi.org/10.1177/0042085913481364>
- Haley, R. D., Oberle, E., Durlak, J. A., & Weissberg, R. P. (2017). Promoting positive youth development through school-based social and emotional learning interventions: A meta-analysis of follow-up effects. *Child Development*, 88(4), 1156-1171. doi:10.1111/cdev.12864
- Han, S. W. (2016). National education systems and gender gaps in stem occupational expectations. *International Journal of Educational Development*, 49(1), 175-187.  
doi:10.1016/j.ijedudev.2016.03.004
- Hansen, K., & Jones, E. M. (2011). Ethnicity and gender gaps in early childhood. *British Educational Research Journal*, 37(6), 973-991.



Harper, S., & Quaye, S. (2009). *Student engagement in higher education: Theoretical perspectives and practical approaches for diverse populations*. New York: Routledge.

History, Art & Archives, U.S. House of Representatives. (2018). *National Defense Education Act*. Retrieved from <https://history.house.gov/HouseRecord/Detail/15032436195>

Huck, S., Cormier, W., & Bounds, W. (1974). *Reading statistics and research*. New York: Harper & Row.

Huitt, W., & Dawson, C. (2011). Social Development: Why It Is Important and How to Impact It. In *Educational Psychology Interactive*. Valdosta, GA: Valdosta State University.

Hyde, J. S., Mertz, J. E., & Schekman, R. (2009). Gender, culture, and mathematics performance. *Proceedings of the National Academy of Sciences of the United States of America*, 106(22), 8801-8807. doi:10.1073/pnas.0901265106

Jambu, M. (1991). *Exploratory and multivariate data analysis*. Boston: Academic Press.

Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research*, 1(2), 112-133. doi:10.1177/1558689806298224

Jones, S. M., Barnes, S. P., Bailey, R., & Doolittle, E. J. (2017). Promoting social and emotional competencies in elementary school. *The Future of Children*, 27(1), 49-72.

- Kahraman, N., & Sungur-Vural, S. (2014). The contribution of gender, socio-economic status and socio-cultural influence to turkish students' task value beliefs in science. *Research in Education*, 91(1), 30-44. doi:10.7227/RIE.91.1.4
- Kennedy, J. F. (1961). *Special message by the president on urgent national needs before a joint session of Congress, May 25*.
- Kramer, D. (2016). The gathering storm still looms. *Physics Today*, 69(11), 29-31. doi:10.1063/PT.3.3360
- Kret, M. E., & De Gelder, B. (2012). A review on sex differences in processing emotional signals. *Neuropsychologia*, 50(7), 1211-1221.
- Lam, K. K. L., & Zhou, M. (2019). Examining the relationship between grit and academic achievement within K-12 and higher education: A systematic review. *Psychology in the Schools*, 56(10), 1654-1686. doi:10.1002/pits.22302
- Lawson, G. M., McKenzie, M. E., Becker, K. D., Selby, L., & Hoover, S. A. (2019). The core components of evidence-based social emotional learning programs. *Prevention Science*, 20(4), 1-11. doi:10.1007/s11121-018-0953-y
- Lee, C. S., Hayes, K. N., Seitz, J., DiStefano, R., & O'Connor, D. (2016). Understanding motivational structures that differentially predict engagement and achievement in middle school science. *International Journal of Science Education*, 38(2), 192-215. doi:10.1080/09500693.2015.1136452
- Lei, H., Cui, Y., & Chiu, M. (2018). The relationship between teacher support and students' academic emotions: A meta-analysis. *Frontiers in Psychology*, 8, 1-12. doi:10.3389/fpsyg.2017.02288

- Martin, A. J., Way, J., Bobis, J., & Anderson, J. (2015). Exploring the ups and downs of mathematics engagement in the middle years of school. *The Journal of Early Adolescence*, 35(2), 199-244. doi:10.1177/0272431614529365
- McMillan, J. H., & Schumacher, S. (2001). *Research in education: A conceptual introduction*. New York: Longman.
- Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. San Francisco, CA: Jossey-Bass.
- Moore, S., & Simon, J. L. (2000). The greatest century that ever was. *The World & I*, 15(3), 76-83.
- National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2007). *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Washington, DC: The National Academies Press.
- National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2010). *Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5*. Washington, DC: The National Academies.
- National Science Board. (2018). *Science and engineering indicators 2018*. Arlington, VA.
- National Student Clearinghouse Research Center. (2015). *Science & Engineering Degree Attainment: 2004–2014*. Retrieved from <https://nscresearchcenter.org/snapshotreport-degreeattainment15/>

- Nelson, R., & Phelps, E. (1966). Investment in Humans, Technological Diffusion, and Economic Growth. *The American Economic Review*, 56(1/2), 69-75. Retrieved from <http://www.jstor.org.unco.idm.oclc.org/stable/1821269>
- NGSS Lead States. (2013). *Next generation science standards: For states, by states*. Washington, DC: The National Academies Press.
- Noddings, N. (1995). Teaching themes of care. *The Phi Delta Kappan*, 76(9), 675-679.
- Noddings, N. (2003). Is teaching a practice? *Journal of Philosophy of Education*, 37(2), 241-251. doi:10.1111/1467-9752.00323
- Noddings, N. (2005). *The challenge to care in schools: An alternative approach to education*. (2nd ed). New York: Teachers College Press.
- Noddings, N. (2015). A richer, broader view of education. *Society*, 52(3), 232-236. doi:10.1007/s12115-015-9892-4
- Noddings, N., & Lees, H. E. (2016). Introduction & this handbook. In H. E. Lees, & N. Noddings (Eds.), *The Palgrave international handbook of alternative education* (pp. 1-13). London: Palgrave Macmillan. doi:10.1057/978-1-137-41291-1
- Nugent, G., Barker, B., Welch, G., Grandgenett, N., Wu, C., & Nelson, C. (2015). A model of factors contributing to STEM learning and career orientation. *International Journal of Science Education*, 37(7), 1067-1088. doi:10.1080/09500693.2015.1017863
- Obama, B. (2009). President barack obama addresses the 146th annual meeting of the national academy of sciences. *Proceedings of the National Academy of Sciences of the United States of America*, 106(24), 9539-9543. doi:10.1073/pnas.0905049106

- Ogle, J. P., Hyllegard, K. H., Rambo-Hernandez, K., & Park, J. (2017). Building middle school girls' self-efficacy, knowledge, and interest in math and science through the integration of fashion and STEM. *Journal of Family and Consumer Sciences*, 109(4), 33-40.
- Olofson, M., & Knight, D. (2018). Does the middle school model make a difference? Relating measures of school effectiveness to recommended best practices. *Education Sciences*, 8(4), 160. doi:10.3390/educsci8040160
- Pajares, F. (2005). Gender differences in mathematics self-efficacy beliefs. In Gallagher A. M., Kaufmann J. C. (Eds.), *Gender differences in mathematics: An integrative psychological approach* (pp. 294–315). Cambridge, England: Cambridge University Press.
- Panorama Education. (2018). Panorama Education. Retrieved from <https://www.panoramaed.com>
- Park, D., Yu, A., Baelen, R. N., Tsukayama, E., & Duckworth, A. L. (2018). Fostering grit: Perceived school goal-structure predicts growth in grit and grades. *Contemporary Educational Psychology*, 55(1), 120-128. doi:10.1016/j.cedpsych.2018.09.007
- Payton, J. W., Wardlaw, D. M., Graczyk, P. A., Bloodworth, M. R., Tompsett, C. J., & Weissberg, R. P. (2000). Social and emotional learning: A framework for promoting mental health and reducing risk behavior in children and youth. *Journal of School Health*, 70(5), 179-185. doi:10.1111/j.1746-1561.2000.tb06468.x

- Peters-Burton, E., & Mattiotti, G. K. (2017). *Building student self-awareness of learning to enhance diversity in the sciences*. In D. D. Liston & R. Rahimi (Eds.), *Promoting social justice through the scholarship of teaching and learning* (pp. 270-295). Bloomington, IN: Indiana University Press.
- Pinxten, R. (2015). *Multimathemacy: Anthropology and mathematics education*. Switzerland: Springer. doi:10.1007/978-3-319-26255-0
- Piper, J. K., & Krehbiel, D. (2015). Increasing STEM enrollment using targeted scholarships and an interdisciplinary seminar for first- and second-year college students. *Journal of STEM Education: Innovations and Research*, 16(4), 36-43.
- Pitzer, J., & Skinner, E. (2017). Predictors of changes in students' motivational resilience over the school year: The roles of teacher support, self-appraisals, and emotional reactivity. *International Journal of Behavioral Development*, 41(1), 15-29.
- Plano Clark, V., & Ivankova, N. (2016). *Mixed methods research: A guide to the field*. Thousand Oaks, CA: Sage Publications, Inc. doi: 10.4135/9781483398341
- Prewett, S. L., Bergin, D. A., & Huang, F. L. (2019). Student and teacher perceptions on student-teacher relationship quality: *A middle school perspective*. *School Psychology International*, 40(1), 66-87. doi:10.1177/0143034318807743
- Ralston, P. (2010). *The book of not knowing: Exploring the true nature of self, mind, and consciousness*. Berkley, CA: North Atlantic Books.
- Ropers-Huilman, R., & Winters, K. T. (2011). Feminist research in higher education. *The Journal of Higher Education*, 82(6), 667-690.  
doi:10.1080/00221546.2011.11777223

- Rueger, S. Y., Malecki, C. K., & Demaray, M. K. (2010). Relationship between multiple sources of perceived social support and psychological and academic adjustment in early adolescence: Comparisons across gender. *Journal of Youth and Adolescence*, 39(1), 47-61. doi:10.1007/s10964-008-9368-6
- Sadker, D. M., Sadker, M., Zittleman, K. R., & Sadker, M. (2009). *Still failing at fairness: How gender bias cheats girls and boys in school and what we can do about it*. (Rev. and updated.). New York: Scribner.
- Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education*, 96(3), 411-427. doi:10.1002/sce.21007
- Saldaña, J. (2016). *The coding manual for qualitative researchers*. London: Sage Publications, Inc.
- Sarabia-Cobo, C. M., Suárez, S. G., Menéndez Crispín, E. J., Sarabia Cobo, A. B., Pérez, V., de Lorena, P., Rodríguez Rodríguez, C., Sanlúcar Gross, L. (2017). Emotional intelligence and coping styles: An intervention in geriatric nurses. *Applied Nursing Research*, 35, 94-98. doi:10.1016/j.apnr.2017.03.001
- Saujani, R. (2016, February). *Teach girls bravery not perfection* [Video file]. Retrieved from [https://www.ted.com/talks/reshma\\_saujani\\_teach\\_girls\\_bravery\\_not\\_perfection?utm\\_campaign=tedsread&utm\\_content=talk&utm\\_medium=referral&utm\\_source=tedcomshare&utm\\_term=education](https://www.ted.com/talks/reshma_saujani_teach_girls_bravery_not_perfection?utm_campaign=tedsread&utm_content=talk&utm_medium=referral&utm_source=tedcomshare&utm_term=education)
- Schueller, S. M., & Seligman, M. E. P. (2010). Pursuit of pleasure, engagement, and meaning: Relationships to subjective and objective measures of well-being. *The Journal of Positive Psychology*, 5(4), 253-263. doi:10.1080/17439761003794130

- Spring, J. H. (2014). *The American school: A global context; from the Puritans to the Obama administration*. New York, NY: McGraw-Hill.
- STEM, Law and Civics: Reading and Writing Institute. (2019). *STEM*. Retrieved from <http://lcrwi.org/stem/>
- Stoet, G., & Geary, D. C. (2018). The gender-equality paradox in science, technology, engineering, and mathematics education. *Psychological Science*, 29(4), 581-593. doi:10.1177/0956797617741719
- Sullivan, B., Hegde, A. V., Ballard, S. M., & Ticknor, A. S. (2015) Interactions and relationships between kindergarten teachers and English language learners. *Early Child Development and Care*, 185(3), 341-359. doi: 10.1080/03004430.2014.919496
- Summers, J., & Falco, L. (2018). Evaluating construct validity of the middle school self-efficacy scale with high school adolescents. *Journal of Career Development, Online First*, 1-18. doi: 10.1177/0894845318773383
- Tai, R., Liu, C., Maltese, A., & Fan, X. (2006). Planning early for careers in science. *Science*, 312(5777), 1143-1144. doi:10.1126/science.1128690
- Tashakkori, A., & Teddlie, C. (2016). *SAGE handbook of mixed methods in social & behavioral research*. Thousand Oaks, California: SAGE.
- Thapa, A., Cohen, J., Guffey, S., & Higgins-D'Alessandro, A. (2013). A review of school climate research. *Review of Educational Research*, 83(3), 357-385. doi:10.3102/0034654313483907
- Trip, S. (2017). Socio-emotional programs; preventing aggressions: emerging themes from 21<sup>st</sup> workshop on aggression 201. *Journal of Psychological and Educational*



*Research*, 25(1), 7-25. Retrieved from

<https://unco.idm.oclc.org/login?url=https://search-proquest->

[com.unco.idm.oclc.org/docview/1946267006?accountid=12832](https://unco.idm.oclc.org/docview/1946267006?accountid=12832)

Upadhyay, B., Maruyama, G., & Albrecht, N. (2017). Taking an active stance: How urban elementary students connect sociocultural experiences in learning science.

*International Journal of Science Education*, 39(18), 2528-2547.

doi:10.1080/09500693.2017.1392645

U.S. Committee on Education and Labor. (1964). *National defense education act of 1958, as amended by the 88th Congress*. Washington, D.C.

U.S. Department of Education. (n.d.). *Science, technology, engineering and math:*

*Education for global leadership*. Retrieved from: <https://www.ed.gov/Stem>

U.S. Department of Education, National Center for Education Statistics (NCES). (2017).

*Digest of education statistics*. Retrieved from

[https://nces.ed.gov/programs/digest/2017menu\\_tables.asp](https://nces.ed.gov/programs/digest/2017menu_tables.asp)

U.S. Department of Education, Office of Educational Technology. (2013). *Promoting grit, tenacity, and perseverance: Critical factors for success in the 21st century*.

Retrieved from <http://pgbovine.net/OET-Draft-Grit-Report-2-17-13.pdf>

U.S. Department of Education, Office of Innovation and Improvement. (2016). *STEM 2026: A Vision for Innovation in STEM Education*. Washington, DC: Author.

Retrieved from <https://innovation.ed.gov/what-we-do/stem/>.

U.S. Department of Education, The National Commission on Excellence in Education.

(1983). *A nation at risk: the imperative for educational reform: a report to the*

*Nation and the Secretary of Education, United States Department of Education*.

Washington, D.C.

- Usher, E., Li, C., Butz, A., & Rojas, J. (2019). Perseverant grit and self-efficacy: Are both essential for children' academic success? *Journal of Educational Psychology*, *111*(5), 877-902. doi:10.1037/edu0000324
- Von Culin, K., Tsukayama, E., & Duckworth, A. (2014). Unpacking grit: Motivational correlates of perseverance and passion for long-term goals. *Journal of Positive Psychology*, *9*(4), 306-312. doi:10.1080/17439760.2014.898320
- Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
- Wang, M., & Degol, J. L. (2017). Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions. *Educational Psychology Review*, *29*(1), 119-140. doi: dx.doi.org.unco.idm.oclc.org/10.1007/s10648-015-9355-x
- Wang, M., & Eccles, J. S. (2013). School context, achievement motivation, and academic engagement: A longitudinal study of school engagement using a multidimensional perspective. *Learning and Instruction*, *28*(1), 12-23. doi:10.1016/j.learninstruc.2013.04.002
- Wang, M., Eccles, J. S., & Kenny, S. (2013). Not lack of ability but more choice: Individual and gender differences in choice of careers in science, technology, engineering, and mathematics. *Psychological Science*, *24*(5), 770-775. doi:10.1177/0956797612458937
- Wright, R., Riedel, R., Sechrest, L., Lane, R. D., & Smith, R. (2018). Sex differences in emotion recognition ability: The mediating role of trait emotional awareness. *Motivation and Emotion*, *42*(1), 149-160. doi:10.1007/s11031-017-9648-0

Zhang, D., & Tang, X. (2017). The influence of extracurricular activities on middle school students' science learning in china. *International Journal of Science Education*, 39(10), 1381-1402. doi:10.1080/09500693.2017.1332797

**APPENDIX A**

**INSTITUTIONAL REVIEW BOARD APPROVAL**



*Institutional Review Board*

DATE: January 28, 2019

TO: Danielle Riney

FROM: University of Northern Colorado (UNCO) IRB

PROJECT TITLE: [1355445-2] Socio-emotional and socio-cultural perceptions of young women and their interests in STEM

SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVED

APPROVAL DATE: January 28, 2019

EXPIRATION DATE: January 28, 2020

REVIEW TYPE: Expedited Review

Thank you for your submission of Amendment/Modification materials for this project. The University of Northern Colorado (UNCO) IRB has APPROVED your submission. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on applicable federal regulations.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of January 28, 2020.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Nicole Morse at 970-351-1910 or [nicole.morse@unco.edu](mailto:nicole.morse@unco.edu). Please include your project title and reference number in all correspondence with this committee.



*Institutional Review Board*

DATE: January 6, 2020

TO: Danielle Riney

FROM: University of Northern Colorado (UNCO) IRB

PROJECT TITLE: [1355445-3] Socio-emotional and socio-cultural perceptions of young women and their interests in STEM

SUBMISSION TYPE: Continuing Review/Progress Report

ACTION: APPROVED

APPROVAL DATE: January 6, 2020

EXPIRATION DATE: \*see note in bold below\*

REVIEW TYPE: Expedited Review

Thank you for your submission of Continuing Review/Progress Report materials for this project. The University of Northern Colorado (UNCO) IRB has APPROVED your submission. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on applicable federal regulations.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

**Under the recently revised Common Rule, this project will not require annual continuing review by the committee. Your project has been assigned a "Next Report Due" date of January 28, 2023.**

**Just prior to that date, the IRB will check in with you to get a current status of your project. This will help us determine if your project needs to be extended or if your study is ready to be closed.**

**If you have completed your project prior to that date, please contact the Office of Research & Sponsored Programs to complete a closing report.**

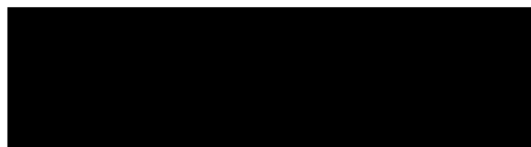
Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Nicole Morse at 970-351-1910 or [nicole.morse@unco.edu](mailto:nicole.morse@unco.edu). Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Northern Colorado (UNCO) IRB's records.

**APPENDIX B**  
**SCHOOL DISTRICT CONSENT FORM**





March 15, 2019

Dear Danielle:

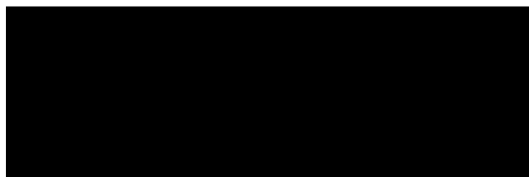
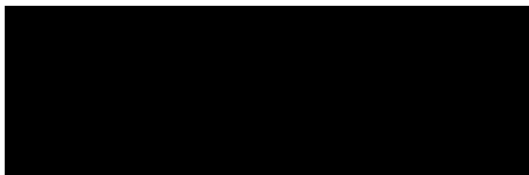
I am pleased to inform you that your request to do research in the [REDACTED] with Middle School-aged students concerning SEL and Socio-cultural perceptions of girls' interest in STEM has been **approved**. We do have a copy of your application and IRB approval through Northern Colorado on file.

In any of your work, please do not make any reference to the [REDACTED] or any specific school— please reference [REDACTED] a “large suburban district in the mid-west” or a school as a “suburban school in the state of Kansas”— or some other reference name of your choice, but do not use the [REDACTED] name or any school names. Additionally, please do not use any student or staff identifying information.

Your mixed methods research study of your middle school students is extremely timely and important to us as well. We look forward to your study and the conversations that will follow concerning the results.

Good luck with your research!

Sincerely,



**APPENDIX C**  
**PARENTAL CONSENT FORM**



**Project Title:** Socio-emotional and Socio-cultural Perceptions of Young Women and their interests in STEM

**Researcher:** Danielle A. Riney, Doctoral Candidate, University of Northern Colorado

**E-mail:** rine4617@bears.unco.edu

**Research Advisor:** Dr. Heng-Yu Ku, Professor, University of Northern Colorado

**E-mail:** hengyu.ku@unco.edu

Dear Parent/Guardian,

Your student has been chosen to participate in a research project to examine the socio-emotional and socio-cultural perspectives of middle school students. The principal researcher is Danielle Riney, a doctoral candidate from the University of Northern Colorado School of education. Her research advisor is Dr. Heng-Yu Ku from the school of education.

The study will be conducted in two parts. The initial focus will require that your student complete a survey inventory on their STEM interests, grit, self-efficacy, and social-awareness (social-emotional learning and socio-cultural learning). Completion of the survey will occur at school during the school day. The second part of the study will be conducted with interviews. Interviews will be held at school or at another agreed upon location. Interviews will be recorded and transcribed.

Participation in the study is completely voluntary. There are no known risks by participating in the study and participants can choose to withdraw from the study at any time with no consequences. Students will not receive compensation for their participation. All information concerning your child will be kept private and confidential by the researcher and will not be released in any individually identifiable form. A pseudonym will be used, rather than your child's name, when the results of the study are defended and published.

A copy of this form will be given to you to retain for future reference. If you have any concerns about your student's selection or treatment as a research participant, please contact Nicole Morse, Research Compliance Manager, Office of Research, Kepner Hall University of Northern Colorado Greeley, CO 80639; 970-351-1910.

\_\_\_\_\_  
Parent/Guardian Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Student's Name

\_\_\_\_\_  
Date

**APPENDIX D**

**PARTICIPANT ASSENT FORM**



ASSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH  
University of Northern Colorado

**Project Title:** Socio-emotional and Socio-cultural Perceptions of Young Women and their interests in STEM

**Researcher:** Danielle A. Riney, Doctoral Candidate, University of Northern Colorado

**E-mail:** rine4617@bears.unco.edu

**Research Advisor:** Dr. Heng-Yu Ku, Professor, University of Northern Colorado

**E-mail:** hengyu.ku@unco.edu

Dear student,

You have been chosen to participate in a research project to examine the socio-emotional and socio-cultural perspectives of middle school students. The principal researcher is Danielle Riney, a doctoral candidate from the University of Northern Colorado School of education. Her research advisor is Dr. Heng-Yu Ku from the school of education.

The study will be conducted in two parts. The initial focus will require that you complete a survey inventory on their STEM interests: grit, self-efficacy, and social-awareness (social-emotional learning and socio-cultural learning). Completion of the survey will occur at school during the school day. The second part of the study will be conducted with interviews. Interviews will be held at school or at another agreed upon location. Interviews will be recorded and transcribed.

Participation in the study is completely voluntary. There are no known risks by participating in the study and participants can choose to withdraw from the study at any time with no consequences. Students will not receive compensation for their participation. All information concerning your information will be kept private and confidential by the researcher and will not be released in any individually identifiable form. A pseudonym will be used, rather than your name, when the results of the study are defended and published.

If you have any concerns about your student's treatment as a research participant, please contact Nicole Morse, Research Compliance Manager, Office of Research, Kepner Hall University of Northern Colorado Greeley, CO 80639; 970-351-1910.

\_\_\_\_\_  
Participant's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Participant's Printed Name

\_\_\_\_\_  
Date

**APPENDIX E**  
**STUDENT SURVEY QUESTIONS**

## Student Survey

#	Question	Scale or Answer					Connects to Research Question #	
<b>A. Participant Demographic</b>								
1	What is your name?							
2	What gender do you identify with?						1, 2	
<b>B. Participant Interest</b>								
3	What is your favorite subject at school?						1, 2, 3, 4	
4	Why is this your favorite subject at school?						1, 2, 3, 4	
5	What is your best subject at school?						1, 2, 3, 4	
6	Why is this your best subject at school?						1, 2, 3, 4	
		5 - Always   4 - Very Often   3 - Sometimes   2 - Rarely   1 - Never						
<b>C. Socio-emotional Questioning</b>		<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>Type of Questioning (not shared with participants)</b>	<b>Connects to Research Question #</b>
7	How often do you stay focused on a STEM idea, goal, or project for several months at a time?	Always	Very Often	Sometimes	Rarely	Never	<b>Grit</b>	1
8	If you fail to reach an important STEM idea, goal, or project, how likely are you to try again?	Always	Very Often	Sometimes	Rarely	Never	<b>Grit</b>	1
9	When you are working on a STEM idea, goal, or project that matters a lot to you, how focused can you stay where there are lots of distractions?	Always	Very Often	Sometimes	Rarely	Never	<b>Grit</b>	1
10	If you have a problem while working towards an important STEM idea, goal, or project, how well can you keep working?	Always	Very Often	Sometimes	Rarely	Never	<b>Grit</b>	1
11	Some people pursue some of their goals for a long time, and other change their goals frequently. Over the next several years, how likely are you to continue to pursue one of your current STEM ideas, goals, or projects?	Always	Very Often	Sometimes	Rarely	Never	<b>Grit</b>	1
12	How confident are you that you can complete all the work that is assigned in your STEM classes?	Always	Very Often	Sometimes	Rarely	Never	<b>Self-efficacy</b>	1
13	When complicated ideas are presented in a STEM class, how confident are you that you can understand them?	Always	Very Often	Sometimes	Rarely	Never	<b>Self-efficacy</b>	1
14	How confident are you that you can learn all the material presented in your STEM classes?	Always	Very Often	Sometimes	Rarely	Never	<b>Self-efficacy</b>	1

<b>C. Socio-emotional Questioning</b>		<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>Type of Questioning (not shared with participants)</b>	<b>Connects to Research Question #</b>
15	How confident are you that you can do the hardest work that is assigned in your STEM classes?	Always	Very Often	Sometimes	Rarely	Never	<b>Self-efficacy</b>	1
16	How confident are you that you will remember what you learned in your STEM classes, next year?	Always	Very Often	Sometimes	Rarely	Never	<b>Self-efficacy</b>	1
17	During the past 30 days...How carefully did you listen to other people's points of view in STEM?	Always	Very Often	Sometimes	Rarely	Never	<b>Social-awareness</b>	1
18	During the past 30 days...How much did you care about other people's feelings in STEM?	Always	Very Often	Sometimes	Rarely	Never	<b>Social-awareness</b>	1
19	During the past 30 days...How well did you get along with students who are different from you (students who are less or more interested in STEM)?	Always	Very Often	Sometimes	Rarely	Never	<b>Social-awareness</b>	1
20	During the past 30 days...How often did you compliment others' accomplishments in STEM learning?	Always	Very Often	Sometimes	Rarely	Never	<b>Social-awareness</b>	1
21	During the past 30 days...How clearly were you able to describe your feelings regarding STEM learning?	Always	Very Often	Sometimes	Rarely	Never	<b>Social-awareness</b>	1
22	During the past 30 days...When others disagreed with you, how respectful were you of their views (particularly in STEM classes)?	Always	Very Often	Sometimes	Rarely	Never	<b>Social-awareness</b>	1
23	During the past 30 days...to what extent were you able to stand up for yourself without putting others down (particularly in STEM classes)?	Always	Very Often	Sometimes	Rarely	Never	<b>Social-awareness</b>	1
24	During the past 30 days...To what extent were you able to disagree with others without starting an argument (particularly in STEM classes)?	Always	Very Often	Sometimes	Rarely	Never	<b>Social-awareness</b>	1



<b>D. Socio-cultural Questioning</b>		<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>Type of Questioning (not shared with participants)</b>	<b>Connects to Research Question #</b>
25	A STEM focus in college can help you get many different types of job.	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
26	When you are NOT in school, how often do you talk about STEM with other people?	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
27	I know how to use scientific evidence to make an argument.	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
28	When not in school, how often do you read books or magazines about STEM?	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
29	When not in school, how often do you go to a science center, science museum, planetarium, zoo, or aquarium?	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
30	How often are you involved in STEM related extra-curricular activities?	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
31	My teachers have specifically encouraged me to continue with STEM areas in the future.	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
32	My teachers have explained to me STEM is useful for my future.	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
33	It is useful to know about STEM in my daily life.	Always	Very Often	Sometimes	Rarely	Never	<b>Socio-cultural</b>	2
<b>E. Socio-cultural Open Questioning</b>								
34	Who has influenced you in your STEM education (For instance, a friend, teacher, etc.)? Explain.						<b>Socio-cultural</b>	2

Note: This survey was modified from two previously used surveys (Archer, Dawson, DeWitt, Seakins, & Wong, 2015; Panorama Education, 2018).

**APPENDIX F**

**SEMI-STRUCTURED INTERVIEW QUESTIONS**

### Interview Questions

These are open-ended questions used for interviews. They served as starting points for conversations between the research and student participant. These questions helped answer research questions three and four.

Question #	Question	Type of Question
1	Where have you heard about STEM careers? (i.e., influences from teachers, parents, peers)	Socio-cultural influences (influences)
2	Do you know of anyone in a STEM career? (i.e., parent, family member, neighbor) a. What do they do? b. Have they spoken with you about their career (the interesting and not so interesting aspects)?	Socio-cultural influences (influences)
3	What do you think about STEM careers? a. What do your peers think about STEM careers? b. What are girls your age taught to think about STEM careers? c. Who teaches that opinion (teachers, parents, peers)?	Socio-cultural influences (peer and gender)
4	Do you think there is gender bias regarding interest levels in STEM? Do you think there is a different gender perception?	Socio-cultural influences (gender)
5	To what extent does peer influence affect your interest levels of STEM?	Socio-cultural influences (peer)
6	To what extent do your parents/guardians influence your interest levels in STEM?	Socio-cultural influences (parents/guardians)
7	To what extent do extracurricular activities affect your interest levels in STEM?	Socio-cultural influences (extracurricular)

**APPENDIX G**

**DRAFT OF RECRUITMENT COMMUNICATION**

[REDACTED]  
Parent/Guardian Research Consent  
[REDACTED]

---

Hello [REDACTED]

Danielle Riney, a seventh-grade science teacher and Science Olympiad coach at [REDACTED] working on her dissertation through the University of Northern Colorado. She is looking for participants for her dissertation research study. You are receiving this email because you are a parent/guardian of a student at [REDACTED].

This study examines the socio-emotional and socio-cultural perspectives of middle school students in STEM (science, technology, engineering, and mathematics).

Please find the link for the Parent/Guardian Consent form, to give consent for your student to participate in this research. Please note, if you have multiple students at [REDACTED] you will need to fill out a form for each student.

If you have any questions about the study, please email Danielle Riney at [REDACTED] or [rine4617@bears.unco.edu](mailto:rine4617@bears.unco.edu).

Please click the following link: [Riney Parent/Guardian Consent](#)

Thank you for your time and help!

---

You are receiving this email because of your relationship with [REDACTED] School. If you wish to stop receiving email updates sent through the Blackboard service, please [unsubscribe](#).  
[REDACTED]

**APPENDIX H**

**DRAFT OF RECRUITMENT EMAIL FOR STUDENTS**

**Danielle Riney**

Student Survey

To: Danielle Riney, Cc: Riney, Danielle

---

Dear Student,

Mrs. Riney, a seventh-grade science teacher and Science Olympiad coach at [REDACTED] is working on her dissertation through the University of Northern Colorado.

Your parent(s) or guardian(s) have given consent for you to participate in research with Mrs. Riney.

You will be receiving a paper QR code to scan in bulldog time. To participate in Mrs. Riney's research, you can scan the QR code or you can click the following link: [https://unco.co1.qualtrics.com/jfe/form/\[REDACTED\]](https://unco.co1.qualtrics.com/jfe/form/[REDACTED]) The link will take you to a webpage with the survey to complete.

Thank you so much for your help!  
Mrs. Riney

**Danielle A. Riney**



CONFIDENTIALITY NOTICE: This message is from the [REDACTED]. The message and any attachments may be confidential or privileged and are intended only for the individual or entity identified above as the addressee. If you are not the addressee, or if this message has been addressed to you in error, you are not authorized to read, copy or distribute this message or any attachments. We ask that you please delete this message and any attachments and notify the sender by return email or by phone [REDACTED].